THE KENT INCORPORATED SOCIETY
FOR PROMOTING EXPERIMENTS IN
HORTICULTURE

ANNUAL REPORT

(SEVENTEENTH YEAR)

1929

I. GENERAL

EAST MALLING RESEARCH STATION

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STAFF.

Director: RONALD G. HATTON, M.A. (Oxon.).

Assistant Director: R. C. KNIGHT, D.Sc. (Lond.), D.I.C.

Technical Officer: N. B. BAGENAL, B.A. (Cantab.).

Pomology: R. G. HATTON.
N. H. GRUBB, M.S.A. (Cornell).
W. S. ROGERS, M.A., Dip. Hort. (Cantab.).
J. AMOS, N.D.H., *Manager* Recorder.
A. W. WITT, N.D.H., *Propagator* and Recorder.
H. M. TYDEMAN, Assistant Recorder, *Plant Breeding.*
Miss A. D. MACKENZIE, Dip. Hort. Sci. (Oxford and Reading), In charge of records.
A. C. PAINTER, Assessor of Market qualities.
R. J. GARNER, Dip. Hort. Sci. (Reading), Assistant Recorder, *Propagation.*
F. H. BEARD, Hort. Dip. (Wye), Assistant Recorder, *Hops.*
W. APPLEYARD, B.A. (Cantab.), Assistant Recorder, *Soil Survey.*
W. A. BANE, B.Sc.Hort. (Reading), Assistant Recorder, *Soil Survey.*
D. H. HAMMOND, Assistant Recorder, *Propagation.*

Plant Physiology: R. C. KNIGHT, of the Imperial College of Science and Technology.
M. C. VYVYAN, M.A. (Cantab.).

Lab. Assistant: Miss I. D. SKINNER.

Mycology and Bacteriology: H. WORMALD, D.Sc. (Lond.), A.R.C.Sc., D.I.C.
R. V. HARRIS, B.Sc. (Lond.), A.R.C.Sc., D.I.C.
M. H. MOORE, Dip. Hort. Sci. (Reading), Special Assistant.

Lab. Assistants: C. CORNFORD and Miss K. CORNFORD.

Entomology: A. M. MASSEE, F.E.S.
W. STEER, B.A. (Cantab.).

Lab. Assistant: Miss K. CORNFORD.

Bio-Chemistry: W. A. ROACH, B.Sc. (Lond.), A.R.C.Sc., D.I.C., A.I.C.

Lab. Assistant: O. USMAR.

Statistics: T. N. HOBLYN, Hort. Dip. (Wye).

Guide Demonstrator and Exhibitions Officer: H. C. CHAPELOW, Meteorological Records.

Horticultural Advisory Officer to Kent County Council stationed at East Malling :
N. B. BAGENAL, B.A. (Cantab.). (1.1.1929—30.9.1929.)
Since Vacant.

Secretary : Miss M. K. GLOVER, F.I.S.A.

Book-keeper : P. R. WOOD.

Director's Personal Secretary : Miss L. E. ALEXANDER.

Clerical Staff : Miss E. M. SHEPHERD, Mrs. E. D. HUGHES, Miss E. M. LAWSON, Miss A. M. COSTIN.

THE IMPERIAL BUREAU OF FRUIT PRODUCTION
is accommodated at East Malling Research Station.

STAFF.

Director : R. G. HATTON, M.A. (Oxon.).

Chief Officer : D. AKENHEAD, M.A. (Oxon.), B.Sc.Agric. (Lond.).

Secretary : Miss H. MCKEAGUE, B.A. (Belfast).

Telephone: Imperial Bureau of Fruit Production—(Aylesford 7188).

VISITORS

Visits may be paid to the Research Station on any week day *by appointment.*

Passenger Station : East Malling Halt. Southern Railway.

Goods Station : Aylesford.

Bus Services by the Maidstone and District Bus Co., every 20 minutes from Maidstone to East Malling Church.

Ditton Corner on the main London—Maidstone Road, with Red Lamp Danger Signal is the turning to the Research Station for visitors coming by road.

Telephones :

The Station will now be served by 2 lines :—
Research Station, *Administrative*—(Aylesford 7229).
Research Station, *Advisory and Technical Service*—(Aylesford 7189).

SECTION I

GENERAL DEVELOPMENT AND ACTIVITIES

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Section I

GENERAL DEVELOPMENT AND ACTIVITIES

Whilst in every branch the Station has maintained its activities, there have been certain outstanding developments during the year. The Empire Marketing Board's invitation to the Station to put forward proposals for creating facilities for the reception of a limited number of Post-Graduate workers and to provide accommodation for the housing of an organization for collecting information upon Fruit Production has, after nearly two years, in a modified form, borne fruit. The first essentials were more accommodation and better equipment, both of which have been provided for by a Capital Grant not exceeding £13,200. The second essential was to ensure that, if Post-Graduate workers were to be admitted regularly to the Station, they should at once be closely associated with the Research Staff without in any way interfering with its normal activities. Consequently a Technical Officer, part of whose duties will be the general shepherding of such students, was appointed. In addition, the Entomological and Statistical Sections which heretofore had been inadequately provided for, and were especially feeling the strain from such outside contacts, were relieved by the making of additional Staff appointments. The Maintenance Grant allowed by the Empire Marketing Board to meet such developments amounts to £2,550 in the first full year, which began on October 1st, 1929. All the appointments, however, had not been made before the end of the year.

On January 10th, 1929, the Committee of the Research Station received and approved a formal letter from the Executive Committee of the Imperial Agricultural Bureaux asking for the Station's concurrence in the establishment of the proposed Bureau of Fruit Production on the premises at East Malling, and in the appointment of Mr. Hatton as Director of this new Institution. Whilst the administration and finance of the two Institutions is to be kept entirely separate, the mutual advantages of the close association between the two are obvious.

The aims and objects of the Bureau will in due course be set forth in its own publications; suffice it here to say that it should be regarded as a clearing house of scientific information upon all matters concerning Fruit Production

throughout the Empire. Mr. D. Akenhead was appointed in April to the post of Chief Officer.

The new premises at our entrance, to be known as the Ditton Laboratories, and erected under the auspices of the Food Investigation Board (Department of Scientific and Industrial Research), have not yet come into occupation by members of Staff from the Cambridge Low Temperature Station. However, we hope that, by the coming apple harvest, they will be in a position to utilize our crops, grown upon trees of known history and cultural treatment. Our grading and packing organisation will then be working in close collaboration with our new neighbours.

Committees.

It is gratifying to report that the personnel of both the Committee of Management and the Executive Committee has remained unaltered throughout the year.

The Committee recorded its regret at the absence of the Director, through illness, at the April Executive and the Annual General Meeting, and its appreciation of the services of the Assistant Director and the Secretary in carrying on so effectively.

The Executive Committee met five times during the year, in addition to the meetings of Sub-Committees.

The chief subjects under consideration besides General Finance were the Development Scheme under the Empire Marketing Board's invitation, the establishment of the Imperial Bureau of Fruit Production at East Malling, the Endowment Fund, the Lease of adjacent land and woodland at Ditton, the Distribution of surplus Experimental Material and the Electrification proposals.

The Annual General Meeting.

The Ninth Ordinary General Meeting of the Society was held on the 30th of April, 1929.

The Sixteenth Annual General Report Part I (1928), and the Balance Sheet for the year ending 30th September, 1928, were presented and approved.

The Third Annual Gathering of members was combined with the Ordinary General Meeting, and approximately 100 persons took part.

Immediately following the Meeting, luncheon was taken in the Packing Shed. The Chairman (Mr. Percy Manwaring) extended a welcome to the guests and gave a short history of the progress of the Station from its infancy. He then introduced Major Walter Elliot, Chairman of the Research Grants Committee, Empire Marketing Board, to the members.

Major Elliot emphasized the importance of co-operation in this, the oldest science. He felt that the team spirit, the linking together of the practical with

the scientific, and the realization that the field work and the work in the laboratory were inter-dependent, which resulted in the evolution of such Research Stations as East Malling, must prove of inestimable world-wide benefit.

Sir George Courthope, M.P., Commander C. Bellairs, M.P. and Lord Cornwallis supported Major Elliot and spoke upon the need and value at the present time of such keen investigational work on behalf of Agriculture and Horticulture.

The Guests and Members finally toured the Plantations and visited the laboratories.

Finance.

The Station has received the following Maintenance Grants through the Ministry of Agriculture for the year 1st October, 1928 to 30th September, 1929 :

	£	s.	d.
Research and Maintenance through the Development Fund	8,344	12	7
Research and Maintenance from the Empire Marketing Board Fund	5,370	0	0

Special Grants from the Ministry of Agriculture have been as follows :—

	£	s.	d.
The Incidence and Control of Apple Scab	248	8	9
Kent Fruit Soil Survey	400	0	0

The Imperial College of Science and Technology has continued its Grant of £90 towards the Physiological investigations.

We also once again tender our thanks for the Annual Contributions received from the following County Councils :—

	£
Kent County Council	200
East Sussex County Council	100
West Sussex County Council	100

We are indebted to The United Potash Company for their second Annual Donation of £200 for use in the extension of our Manurial Trials.

The Imperial Chemical Industries have made a grant of £250 for the year 1929, in aid of the general Research Work of the Station. We both record our thanks for this help, and express our hope for its continuance.

The total Sales of Produce during the year 1st October, 1928 to 30th September, 1929, amounted to £4,065 14s. 5d.—the highest yet recorded.

MEMBERSHIP SCHEME.

The fund from the Membership Scheme shows a slight increase for the year 1929. The total amount received was £416 5s. 3d., and the interest thereon £14 11s. 3d.

For three years now this fund has paid for the publication of the Annual Report I—General, and it has covered the cost of the Annual General Meeting and Members' Day. In addition, last year it was possible to allocate the sum of £150 6s. 6d. towards Building Maintenance.

New Members were enrolled during the year as follows :—

4 Associate Members, Life "Founders."
1 Associate Member, Life "Fellow."
4 Associate Members, Annual "Fellows."
45 Associate Members, Annual "Associates."

DEVELOPMENT FUND—Endowment Scheme.

The launching of the appeal prepared in connection with the Development (Endowment) Fund and circulated with the last Annual Report could not be pressed until official confirmation of a £ for £ grant from Government sources came to hand. The Development Commission has recommended, and the Treasury now sanctioned, a Maximum Capital Grant of £15,000 on the £1 for £1 basis. As each £5,000 stage is reached the equivalent sum will now be forthcoming from Government sources. It is therefore hoped that this added inducement to donors will result in the rapid accumulation of the desired amount in the forthcoming year. The first £1,000 is now in the bank and for this our thanks are due to Viscount Rothermere and Sir Bernard Greenwell. A further £4,000 will ensure an invested capital of £10,000—a third of the way towards our ultimate goal.

LAND AND BUILDINGS.

During the year a small arable field, "Upper Grub," approximately 10 acres, adjoining our Nursery Ground on Newgates, was offered to the Station on a long lease and secured for the growing of temporary crops.

The new "E.M.B. Building," designed by Major Maule and destined to house the new Imperial Bureau of Fruit Production, the Technical Officer and his Staff, and allow for the more adequate accommodation of the Library and Pomological Laboratory, was started in August. It should be nearly completed by the date fixed for the Annual General Meeting.

STAFF.

During the year several additions have been made to the Staff under the Empire Marketing Board's Scheme : Mr. N. B. Bagenal was appointed on

October 1st as Technical Assistant, and Mr. W. Steer's position as Assistant Entomologist has been stabilised.

Mr. W. A. Bane joined the Staff as Assistant on the Fruit Soil Survey work and before the end of the year took over a large measure of responsibility for the Pomological Survey.

Mr. W. Appleyard, B.A., with whom he was collaborating, was granted special sick leave in September. We deeply regret having to record the fatal termination of his illness early in 1930. His work showed exceptional promise.

A full-time Chemist to collaborate with our Pathological Sections is much needed.

After an association lasting some nine years, the Administrative Staff lost the services of Miss M. B. Hoad upon her marriage early in the year. Our good wishes go with her.

Miss L. E. Alexander was appointed to the post of Personal Secretary to the Director.

Miss A. M. Costin has joined the Staff as a Junior Clerk.

Post-Graduate and Overseas Workers.

By arrangement with the Egyptian Ministry of Agriculture, Mr. Mahmoud Beshir, of the Plant Protection Section, came in May for a year's study with the Entomological Section.

By arrangement with the Colonial Office, Mr. H. K. Hewison, Department of Agriculture, British Togoland (Gold Coast) and Mr. F. R. Tubbs, preparatory to taking up an appointment in Ceylon, came for several months to associate themselves especially with the Physiological Section. Whilst their periods for study were all too brief, they threw themselves wholeheartedly into the work of the Section.

Miss J. Hamond, B.Sc. (Bedford College) came to the Station in September to put in a year's voluntary work with the Pathological Section, specialising on the bacterial diseases of Walnuts, and also the troubles developing in storage. Her interest in this subject has proved such that it is hoped she may later be able to specialise on nut problems in general.

Visits of all too short duration, but with specific purposes in view, were paid by Mr. M. B. Davis (Ottawa), Mr. G. N. Alema (Oxford and Gold Coast), Mr. J. O. Irwin (Rothamsted), Mr. Ahmed (Edinburgh and Egypt), and Messrs. T. P. McIntosh, J. W. Hall and G. Stuart (College of Agriculture, Edinburgh).

From without the Empire came Mlle. A. Ronse, an old student of Vilvorde, Belgium, and M. Emil Johansson, research Botanist from Alnarp Agricultural College, Sweden, for periods of study.

Staff Meetings, 1929.

Eight meetings were held during the year, with an average attendance of twenty-eight.

In the Autumn session, three meetings were devoted to the discussion of the programme of work of various departments.

Mr. E. A. Bunyard gave an address on Grape Growing in France, illustrated by lantern slides, which was very much appreciated by the Staff.

Mr. Howard Spence kindly repeated his lecture on Walnut Culture recently given to the Royal Horticultural Society. The interest aroused was well shown by the large number of questions which followed.

The Social and Athletic Club.

The membership at the end of the year totalled ninety-seven as against ninety-eight in the previous year.

The Summer outing to Margate was well supported, and the Chairman led a most enjoyable ramble in Knowle Park. As in previous years, the Christmas Supper and Party proved a great success. Ten cricket matches were played and one Tennis Tournament was held.

Collaboration.

The full Joint Staff Meeting with Long Ashton has been arranged for early in 1930. During the year numerous useful exchanges of visits have taken place between individual members of Staff. We have welcomed the opportunity of supplying Mr. T. Wallace with some material from our manurial and rootstock field trial plots for his analytical work, and we appreciate the fact that he has kept us in close touch with the results he is obtaining.

A discussion of the Hop Research programmes of Wye and East Malling took place with Professor Salmon and Mr. Burgess, and lines of future collaboration were agreed upon.

The Fruit Soil Survey work, undertaken in conjunction with the S.E.A. College, Wye, ensures frequent contacts with Dr. Goodwin and Mr. Gethin Jones. A joint progress report has been drawn up.

The Biochemical Section, with the generous help of the authorities of the Imperial College, has been able to avail itself of Professor Dingle's experience in Spectroscopy.

Our close association with Mr. M. B. Crane, of the John Innes Horticultural Institution, is fully maintained through our extended programme for the breeding of new rootstocks.

The close collaboration with Professor Blackman and the Research Institute Imperial College, is maintained through the medium of Dr. Knight's intimate association with East Malling.

Advisory Work.

Correspondence.

The total number of written replies to queries was 1,199. A further 32 were referred to the County Horticultural Officer. There was again a big increase in the number dealt with by the Entomological Section, *i.e.*, 261 as against 217 in the previous year.

The anxiety expressed during the past few years as to the ways in which this demand on the investigators' time could be met, has now been allayed. In future, Mr. N. B. Bagenal, in his capacity as Technical Assistant, will act as a clearing house for these enquiries. It is hoped that, in order to expedite matters, our members will now address all queries *of a general nature* direct to Mr. Bagenal.

A detailed analysis of the nature of these queries again shows that the great majority of them arise as a result of the interest of growers in the specific subjects under investigation at the Station.

Once again enquiries from the main contributing Counties, Kent (427), Surrey (61), East and West Sussex (77), outnumbered those of any other individual County. There was a notable increase in letters from Norfolk, Suffolk and Cambs. (85), the Councils of two of which have now joined our Membership Scheme. Practically half the queries come from other sources. Some forty-eight enquiries were dealt with from Overseas correspondents, and some thirty-seven outside the British Empire. In the former case, the assistance of the Bureau was not infrequently sought and was readily given.

In addition, a very large number of enquiries has been dealt with over the telephone. Indeed, this service has now reached such proportions that, at the busy periods of the day, our single line is quite inadequate to cope with administrative and advisory demands. It is hoped in the forthcoming year to establish a separate line in the new building where the " extension " service will be concentrated.

Visits.

The total number of advisory visits to growers' plantations made by members of Staff was 143, the majority of which were once again in Kent and Sussex. This does not include the 98 visits paid by Mr. Bagenal in the course of his County Advisory work. In addition, a large number of new contacts has been made with fruit growers in the area in course of the Fruit Soil Survey work.

" Roguing " operations on small fruits and rootstocks were carried out on two farms during the year.

The services of the Staff were again in demand for judging at various shows and farm competitions.

Mr. R. V. Harris made a tour of the Evesham—Pershore district, in conjunction with the Pathological Staff at Long Ashton, in the course of which he visited twelve growers.

Lectures, Demonstrations, Conferences.

Lectures.

Fourteen lectures, seven dealing with pathological subjects, were delivered by members of Staff ; these included the Masters Lectures at the Royal Horticultural Society's Meetings. A number of other papers were read before scientific societies. Owing to the Director's illness, several lectures had to be cancelled. In one instance, at Guildford, Mr. T. Wallace of Long Ashton very kindly took over the engagement, whilst Mr. Bagenal gave the course of three lectures and two demonstrations at the Board of Education's Rural Science Course for Schoolmasters at Homerton College, Cambridge. In view of the development of rural education, such a contact as this is welcomed by the Research Station, and the participation in this course once again has already brought practical results.

Demonstrations.

Apart from the demonstration of a high powered motor spraying machine, kindly lent by Mr. H. B. Weston, Rocks Farm, East Malling, on " Members' Day," no others were publicly organised. Throughout the fruit picking season, almost continuous demonstrations of grading and packing methods for marketing under the National Mark were being given by Mr. A. C. Painter to visitors.

Mr. A. W. Witt gave twenty-five demonstrations in methods of propagation.

Conferences.

At the request of the Kent County N.F.U. Fruit and Vegetable Committee, a Conference was held in the Packing Shed on April 17th to discuss the subject of Spray Damage to Fruit Trees. Over 200 growers attended and a keen discussion took place. The principal outside speakers were Professor E. S. Salmon, Dr. Pethybridge, Mr. R. W. Marsh of Long Ashton and Mr. R. Hart of Essex.

In July a party of the Horticultural Superintendents of the Eastern Counties Province gathered at the Station for two days of informal conference, and inspection of the experimental work. Such chances of exchanging ideas with the County Horticulturists in other areas are mutually agreed to be most valuable, and are heartily welcomed by the Station.

Various members of Staff attended and took an active part in the following Conferences during the year : The Imperial Mycological Conference, the Conference of Empire Meteorologists, the Conference on Polyploidy, and three Wye Provincial Conferences (Horticultural Section).

Whilst the Station cannot participate in or be represented at such Conferences without considerable expenditure of both time and money, this is felt fully justified in view of the important subjects debated and contacts made.

The calls upon the services of various members of Staff on outside Committee work has, if anything, increased.

Exhibits.

The activities of the Exhibits Section have been very largely concentrated during the past year upon showing the results of the Station's recent excavation work on the root systems of ten-year-old apple trees. A technique was successfully evolved for dismantling and reassembling the specimen trees at the various Shows.

At the invitation of the Empire Marketing Board a most comprehensive exhibit was arranged in its Section at the Imperial Fruit Show, Birmingham. Specimen trees of Lane's Prince Albert upon the four root systems (IX, II, I and O.F.5) with the roots arranged in their natural positions, were staged. They aroused an exceptional amount of interest. In addition to these trees the Station's work on rootstock standardisation was illustrated in considerable detail.

Modifications of this exhibit were staged at the Annual Spring Show of the Royal Horticultural Society, Chelsea, the Kent County Show, Folkestone, and the Tunbridge Wells and South Eastern Counties Show at Tunbridge Wells.

It has been the most ambitious exhibit yet staged by the Station and has in consequence entailed a far greater expenditure of time and money than in any previous year. The actual time occupied in staging and packing, together with the attendance of various members of Staff, amounted to 124 one-man days.

Exhibits of a more general character, illustrative of our work on the "Improvement of Fruit Quality" were staged at Canterbury and Ash.

As in previous years an exhibit dealing with Soft Fruit Culture was sent to the Cherry and Soft Fruit Show at the R.H.S. Hall, Vincent Square.

An exhibit which aroused widespread attention was that of the Propagation and Selection of Walnuts staged by Mr. A. W. Witt's Section, at the Walnut Show of the Royal Horticultural Society.

At the invitation of the National Farmers' Union headquarters, a selection of extra fancy fruit in trays was sent by the Marketing Section for display on the N.F.U. Stand at the Imperial Fruit Show.

Visitors.

The total of visits recorded as being paid was 1,499 as against 1,708 in 1928. On the other hand, 26 organised parties were shown round, an increase of at least four over the previous year.

Recorded Visitors, 1929.

Month.	No. of days on which visits were paid.	No. of visitors per month.
January	12	22
February	16	22
March	20	40
April	22	383
May	19	233
June	19	148
July	24	206
August	21	126
September	20	113
October	24	112
November	14	60
December	15	34
Total	226	1,499

Individual visits have been paid on no less than 226 days. As in previous years a large number of Overseas visitors were entertained, including representatives of all our great Dominions. In this the Bureau took its share.

We were pleased to welcome a party of seventeen American Professors touring under the auspices of the United Potash Company.

The organised parties of Home Growers included the Ash and Sandwich branches of the National Farmers' Union, and the East Norfolk Growers' Association.

We are especially pleased to record that two Fruit Growers found it worth while to bring members of their Staffs to visit the Station: these were Mr. Stanley Chivers, of Histon, Cambs., and Mr. Van de Have, from Capelle, Holland.

As evidence of the interest taken in the work of this Station by persons not immediately concerned with fruit growing, the visits of "The Men of Trees," Nature Study parties and the East Malling Women's Institute are worthy of record.

As in previous years, parties of students from Wye College, Reading University, Swanley College, and Borden Farm Institute were given demonstrations. Parties of children from the East Malling Schools, Maidstone Girls' Grammar School and the Maidstone Technical Institute were conducted round the Station on various occasions.

The Minister of Agriculture, Mr. Noel Buxton, accompanied by Sir Charles Howell Thomas, Permanent Secretary Ministry of Agriculture, paid an informal visit to the Station in October.

Fruit Soils Survey in Kent.

The general pomological survey of the Hythe Beds from east to west has been completed. Records were taken on seventy-two farms embracing an area of approximately 2,500 acres of fruit. Meanwhile Dr. Goodwin and Mr. Gethin Jones, of Wye College, have continued their classification of soil types. In June, a Joint Progress Report from Wye College and East Malling was submitted to the Soil Surveys Committee, who recommended continuance of the grant for this work.

Outside Trials.

It has been found possible for one more year to undertake the pruning and keep some detailed records on the rootstock trial plots at Swanley Horticultural College and Wisboro' Green, West Sussex. The grubbing of the similar plot at the Royal Horticultural Society's Gardens, Wisley, afforded a magnificent opportunity for extending our root excavation work.

A spraying trial against Loganberry beetle was carried out by the Entomological Section upon a neighbouring farm.

We wish to thank all those concerned in extending to us the necessary facilities.

Distribution of Surplus Experimental Material.

During the year, besides our normal membership distribution, investigators in Africa, Australia and Tasmania, Canada including Nova Scotia, India and the Irish Free State, availed themselves of the opportunities offered for obtaining small quantities of clone material. Experimental Institutions in Belgium, Denmark, Finland, Germany, Holland, Sweden, Switzerland and the United States also received small consignments.

"Journal of Pomology and Horticultural Science."

The editorial and clerical work in connection with the "Journal" has again been undertaken by the Station, though, during the Director's absence, Mr. H. V. Taylor of the Ministry very kindly took over the responsibility.

Station's Publications.

Beside the Annual Report I—General for 1928, which included seven popular articles for Fruit Growers, fifteen other reports have been published. Summaries of these will be found in Section III of the present Report. A

revised list of all the Station's publications to date, classified under subject headings and properly referenced, has been printed for the information of enquirers.

Library.

The Library has been in process of card indexing on the Brussels Decimal Classification System for the special use of the Bureau. It has, therefore, been passing through a transition which should ultimately make it far more serviceable. Members of Staff have nevertheless continued to use the facilities freely.

During the year the records show that 81 books and 407 periodicals, bulletins, etc., were taken out on loan.

We would again tender our thanks to the following donors of books and periodicals :

N. B. Bagenal, Esq.
H. R. Beeton, Esq.
The Editor, " Citrus Grower " (South Africa).
The Hon. Mrs. Adrian Grant Duff, Hon. Sec., " Men of the Trees."
W. F. Emptage, Esq.
Professor U. P. Hedrick.
Messrs. Nitram, Ltd., associated with Imperial Chemical Industries, Ltd.

Administrative Work.

The development of the Station is still in progress and the work has considerably increased, although the sharing out of responsibilities, now made possible, should ultimately relieve pressure on any particular section. The varied work of the Office has been set out in detail in previous Reports, and under all headings the past year's activities show a considerable increase.

The Membership Scheme and Development (Endowment) Fund both occupy the attention of the Office.

The clerical work connected with the distribution of stocks, shipping of same, etc., has increased.

The issue of stores automatically increases with additional Staff appointments and the advent of voluntary workers.

We have, as in previous years, extended hospitality to a large number of visitors, as an earlier section indicates.

Section II

The Farm

Section II

THE FARM

By J. AMOS and A. C. PAINTER.

Seasonal Conditions.

Frosts of extreme severity, extending from the middle of January until well into March, had the effect of delaying all plant growth. In consequence the blossoming season of all fruit was much later than in 1928.

From records taken at the Station it was found that the date of blossoming was on the average some fourteen to twenty-one days later for most fruits, and, in one case, that of the Cherry Plum (Myrobolan), twenty-eight days later. One result of this retarding effect was that practically all varieties of each class of fruit blossomed together and the actual blossoming period was considerably shortened. This fact, coupled with ideal weather conditions, was probably responsible for the heavy set of practically all kinds of fruit.

The Marketing Season.

With new plots coming into bearing and the increasing age of the plantations, the amount of fruit to be marketed is increasing rapidly year by year and our marketing season is becoming more extended. It now commences with the picking of green gooseberries in May or early June, is closely followed by the strawberry crop and continues on until January or February when the last of the Bramleys and other late apples are marketed.

Strawberry Crop.

The strawberry trial, consisting of Royal Sovereign, gave its first crop, but, owing to the drying out of the soil during the frost period many of the plants were weakened. This materially affected their yield. Further, owing to the lack of rain, the season was short and the fruit somewhat on the small side. Good prices, however, were obtained, especially for the selected fruit in punnets.

Raspberries.

Raspberry canes were, in a few instances, killed by the early frosts, but the damage was not extensive. Drought was once again the most serious factor. It not only greatly reduced the crop, but also apparently had the effect of delaying the colouring of the berries. The variety, Lloyd George

resisted the drought best ; Red Cross and Pynes Royal were seriously affected. Prices obtained for the fruit were, on the whole, satisfactory.

Currants.

Both Red and Black Currants produced heavy yields. Whilst the former made satisfactory prices the latter were most disappointing from a marketing point of view. A few fetched 6d. a lb. but the large proportion sold for between 3d. and 4d., and, at the end of the season, when in previous years prices were expected to rise, the demand went, good samples of fruit selling as low as 2d. per lb.

Apple Crop.

Most varieties of apples, especially Bramley Seedling, Gladstone, Worcester Pearmain and Cox's Orange Pippin yielded heavy crops. The fruit however, owing to the drought, was inclined to be on the small side, and as was the case two years ago very low prices were obtained for the smaller grades especially during the middle of the season. Prices though off set by the larger crops, were generally lower than last year. Cox's Orange Pippin however, was an important exception, the fruit for this variety being of good colour and finish, realized very satisfactory prices.

Thinning was again carried out where practicable. Except where definite thinning experiments are in progress, this was confined as last year to reducing trusses to single fruits so as to interfere as little as possible with experimental results. The large collection of dessert varieties of apples grown as cordons on Jaune de Metz (No. IX.) produced excellent crops of fruit of good size and colour. The flavour was, however, in many cases disappointing and is possibly attributed to the fact that they were grown on an old hop garden soil which had in the past received very generous manurial treatment—mainly nitrogenous in character.

Diseases and Pests.

Scab was not troublesome during the season, only two applications of fungicides being made viz. : one pre-blossom Lime Sulphur (1.29) and one post-blossom spray of Lime Sulphur (1.99). The routine tar-distillate spray was applied during the winter.

Pears.

For the first time, a moderate quantity of pears was available for marketing. Dr. Jules Guyot, Conference, Souvenir du Congres and Emile D'Heyst were the principal varieties. These found a ready market at satisfactory prices.

PLUMS.

Plums once again were variable, Myrobolan, or the Red Cherry Plum for the second year in succession cropped heavily, whilst Czars, Belle de Louvain, Pershore Egg, Victoria, Giant Prune and Warwickshire Drooper all gave very fair to good yields. With the exception of second grade Czars which were on the small side, prices were satisfactory throughout, especially in the case of Victoria and the later plums. Fruit of any quality or size was marketed in 12 lb. chips and the remainder in half sieves.

Morello Cherries cropped heavily and sold well.

HOPS.

The hop crop was grown with comparatively little trouble during the past year. Downy Mildew, although present in the " spike " form in the early part of the year, did not cause any further trouble, thanks to the dry weather, and the cones were free from the disease at picking time.

Aphis was almost entirely absent during the greater part of the season, and spraying was reduced to a minimum, only two applications being given. However, at picking time, both Aphis and Red Spider developed with great rapidity and caused considerable damage to the later varieties. Coming at this late period, it was impossible to adopt remedial measures without causing damage to the cones.

During the past season a strict survey has been made of the large number of seedling Hops under trial and in consequence heavy grubbings have been made during the winter of all those varieties which show no outstanding promise.

RED SPIDER.

Probably the most serious pest at the Station during the past year has been the very severe outbreak of Red Spider on all plants. There is little doubt that the very dry conditions prevailing throughout the summer aided the rapid spread of this pest. Unfortunately the worst infestation took place when the trees and bushes were in fruit. This made the use of sulphur sprays a somewhat risky procedure.

The Green Capsid (*Lygus pabulinus*) so serious a pest on Black Currants in 1928 was almost entirely absent during the past year. Very thorough nicotine sprayings given in that year were apparently successful in eliminating this pest.

GENERAL.

The four acres that it is proposed to plant with apples at the end of 1930, for studying the effects of various manurial treatments, was again cropped with

spring oats and harvested in $\frac{1}{40}$ of an acre plots. This makes the third oat crop in succession, without any manurial assistance and the yield of both straw and corn was as expected very poor.

Wheat was sown on this ground in the autumn, and, it is hoped that with its deeper rooting system the fertility of the soil will be still further reduced.

Although the drought conditions were not favourable to ready rooting of stocks on the stool beds, nevertheless the recently planted stool beds on the Newgates Field produced an abundant supply of layers, the majority of which were sufficiently rooted for distribution or planting out.

The only new planting of note that has been made is a further two acres of strawberries. This area is mainly devoted to Royal Sovereigns, and is a repetition of the trials planted in 1928 to test "strain" and various times of planting. A collection of strawberry varieties has also been planted.

A further addition has been made in regard to land. The ten acre field adjoining the Newgates field and known as "Upper Grub," has recently been leased. The whole was devoted to corn crops during the past season, a part of which was sown with clover in July. This field will be used for nursery work and temporary crops.

Section III

Brief Progress Report of Investigations and Summaries for Fruit Growers

Part I

Pomology

Part I

POMOLOGY

A. In relation to Tree Fruits

(*a*) ROOTSTOCK INVESTIGATIONS.

1. Stocks for Apples.

In the tenth year, trees on nearly all varieties of rootstock bore considerable crops, the detailed recording of which is providing valuable data from which to deduce the suitability of different combinations of stock and scion for particular purposes and schemes of planting. A general review of these investigations has demonstrated the extent to which particular scion varieties, soil and manurial conditions may modify any general grouping of stocks. On the other hand, rootstock influence is becoming accentuated with the age of the tree.

2. Stocks for Pears.

The behaviour of trees on a range of Quince Stocks has been reported upon. The trees on vegetatively raised Free Pear Stocks are already showing differences in growth.

3. Stocks for Plums and Peaches.

A full report on the behaviour of Hales Early Peach upon series of nursery trees, trees grown in pots under glass, and fan trained trees in the open is in course of preparation. " Incompatibilities " in the nursery are not in-frequent ; the fruiting capacity of the pot trees has been obviously affected by rootstock, whilst striking differences in vegetative features have appeared in the fan trained trees.

4. Stocks for Cherries.

Sweet Cherries (P. *Avium*).

Rootstock influence on the scion has in the past year become more marked in at least one direction—that of susceptibility to disease (Bacterial Die-Back). One particular variety used as a stock is itself highly susceptible, and appears also to make the scion more susceptible to this disease. The first orchard of Standard trees of three varieties of cherry on different layered stocks has been planted out on 6 acres.

Acid Cherries (*P. Cerasus*).

A heavy crop of fruit of Morello has indicated that the rootstock may to some extent influence the amount of fruit borne, its size, and perhaps its time of ripening. A younger series of trees is beginning to show considerable stock influence on vigour of growth.

(*b*) ANALYSIS OF ROOTSTOCK INFLUENCE AND THE RECIPROCAL EFFECT OF SCION UPON STOCK.

The series of bench grafted trees referred to in the last report have made excellent growth during the season, and a number of them have been lifted during the present winter for examination of the root characters. A report on the results of this examination is being prepared for publication in collaboration with the Physiology section. The remainder of the trees have been left *in situ* to see whether these trees—grafted on to piece roots—all stock stem having been eliminated—manifest any signs of rootstock influence. All scion rooting has been successfully prevented.

(*c*) ROOT EXCAVATIONS.

A preliminary report of this work has been published. With an improved technique, the operations were continued during the year, in collaboration with the Physiology Section. Five eleven-year-old Lane's Prince Albert apple trees on a series of known rootstocks at East Malling (Hythe Beds) and thirteen ten-year-olds on the Bagshot Sands at Wisley were excavated. It was thus possible to compare the behaviour of the same rootstocks under very different soil conditions. The ratio of root to branch weight differs greatly according to the soil type. Thus whilst the weight of roots was about equal to weight of branches at Wisley, it was about half the weight of branches at East Malling. The vigour of growth does not necessarily depend upon depth of rooting, which varied greatly according to local conditions.

The actual growth of the roots is obviously greatly affected by various soil factors such as texture, moisture, aeration, etc. However, both on the loam and sand the type of root system of the different stocks was so distinctive that there was little possibility of mistaking their general characteristics. The records are still under review and the work is being developed.

From a practical point of view, it was instructive to find that the fine fibrous absorbing roots were fairly evenly distributed over the whole root spread—not just around the trunk where a mulch is so often applied. The spread of roots was often more than twice the spread of branches.

(*d*) DOUBLE-WORKING. Apples and Pears.

The effect of the use of an intermediate scion between the rootstock and the scion forming the head of the tree, has been under investigation with apples and pears for ten years. There seems definite evidence of an influence of the intermediate on vigour of growth, in one case so pronounced as to suggest partial incompatibility ; there may also be an influence on fruit colour, and probably in some cases on precocity and perhaps time of ripening. It also appears that the length of the intermediate affects the result, a longer piece of stem of the variety used as intermediate having more influence (in the same direction) than a shorter piece. The data so far collected are now being analysed.

(*e*) PRUNING EXPERIMENTS.

1. Apples.

The trees have now passed beyond the early stages when such details as length of spurring affect the results. The main problems now are the maintenance of fruit quality and the restriction of the trees to within reasonable size.

2. Pears.

Most of the twelve varieties worked on Quince roots, which have now been subjected to various methods of pruning for five years, bore their first considerable crop in 1929. Even at this early stage the effects upon size and quality of fruit were apparent.

(*f*) MANURING OF APPLES.

1. Potash.

The drought of the past summer resulted in severe leaf scorch even on the potash treated plot. It appears likely that several more annual dressings of potash must be given, or at least that several years more must elapse before the treated trees are able to resist severe drought conditions. The difference between the treated and untreated plots was nevertheless considerable ; two or three of the few previous exceptions have now fallen into line with the majority and clearly show the beneficial effects of potash feeding.

2. General.

The indications described in the last report that the withholding of manures from young apple trees was becoming evident by the eighth year, were strikingly intensified by the heavy crops of fruit borne both on the manured and unmanured plots in the current season. Not only were the size, colour and quality of the fruit grown under starved conditions manifestly inferior, but the trees indicated both in foliage and growth that some immediate remedial treatment would be

necessary. The trees are now ten years old, and demonstrate that at any rate under conditions such as prevail at East Malling systematic feeding is essential for the growing of good trees and fruit.

At the same time there is a marked difference in the response of the same varieties upon different rootstocks to conditions of starvation or complete balance. A full report is in preparation.

(*g*) FRUIT BREEDING.

1. Rootstocks.

In collaboration with the John Innes Institution the comprehensive programme of crosses between different varieties of apple rootstocks with a view both of raising Woolly Aphis immune stocks and also a more complete range of root system is proceeding according to plan. Some of these new stocks have now been vegetatively multiplied in sufficient quantity to permit of preliminary testing. Similar work is proceeding in the case of plum rootstocks, ready vegetative propagation being here one of the characters sought.

2. Varieties.

The first batch of seedlings, raised from crosses in 1928, with the object of obtaining a succession of highly coloured good flavoured dessert apples, are ready for planting out.

Further observations made during the past season relative to the possibility of hastening the cropping period of such seedlings by the use of dwarfing rootstocks confirmed the report already published that this appears likely.

(*h*) FRUIT SOIL SURVEY OF LOWER GREENSAND IN KENT.

During the course of the first year the pomological staff (in working collaboration with the soil chemist at the South-Eastern Agricultural College, Wye), made a field to field survey of an area between Egerton and West Peckham of approximately 2,275 acres. An " average " standard of tree vigour has been arrived at, and one of the striking facts would appear to be the relative importance of the influence of good and bad cultural treatments upon the tree's behaviour as compared with anything but extreme soil variations.

(*j*) WALNUTS.

Successful methods for propagating young walnut trees under glass true to variety, have been reported upon. Experiments in outdoor budding and grafting have been continued.

Methods of layering in the open ground have been tested in the hope of standardising the rootstock as well as the scion. Considerable success has been obtained in rooting young shoots of selected *Juglans regia, J. nigra,*

J. cinerea, *J. sieboldiana* and the hybrids *J. paradox* and *Royal* during the past season.

(*k*) PYRETHRUM.

A number of plants from seedlings of Japanese origin have been selected for their vigour and bloom production, and are being multiplied vegetatively. The flowers from the resulting clone races will be tested for their comparative toxic value.

B. In relation to Bush Fruits.

(*a*) CURRANTS.

The variety trials are being continued, and the question of nomenclature followed up. A report on means of distinguishing the "rogue" varieties circulating as Baldwin Black is in preparation. *The genetic studies* are being considerably developed, the idea of inter-species crossing as a means of improving existing varieties being tested. A paper on the genetic constitution of the main groups of Black Currant has been prepared, and whilst showing that most varieties when selfed breed comparatively true, it throws light upon the relationship of the different sorts comprised in the French Seabrook Group.

The Manurial Trials, probably as a result of two exceptionally dry summers, and comparatively poor crops of Black Currants, have so far yielded no significant responses to the different times and applications of nitrogen.

(*b*) RASPBERRIES.

Variety Trials, etc. A successful beginning has been made in the attempt to raise mosaic disease free stocks of a number of commercial varieties.

Manurial Trials, upon the varieties Lloyd George and Pyne's Royal are being continued, but it will be some seasons yet before any safe interpretation can be placed upon the results. Cane measurements as well as fruit weights are being recorded.

C. Strawberries.

STRAIN AND TIME OF PLANTING.

Detailed crop records were taken on the 3 acres of Royal Sovereign strawberries planted 1927-28. These showed that although the performance of the plants from different sources has been evened up considerably by the elimination of bad plants, one "strain" cropped significantly worse than the other two.

It is interesting to note, however, that the selected progeny of these parents, planted 1928-29, show no significant differences between the three " strains " in their first year's crop. It would appear that the drastic roguing given to the parents, with careful selection of the runners, has practically eliminated the original differences between these so-called " strains."

Besides crop records on the " strain " and " time of planting " trials (planted 1928-29), a complete plant to plant survey was made in August including measurement of size of plant. These records reveal significant differences between different times of planting, both in vigour and cropping. The August, 1928 planting was a failure, owing to the dry conditions following. It was again impossible to plant in August 1929 owing to drought. The October planting gave very satisfactory results, but each successive planting afterwards was progressively less vigorous. It seems obvious that the weather conditions prevailing in each locality and not the calendar, must be the guide as to the optimum planting season. A suggestive point is raised by the fact that the runners planted in March, 1929 cropped more heavily than those planted in December, 1928 (which had made more growth), thus showing that under certain conditions cropping of strawberry plants does not vary proportionately to their size.

Statistics and Records.

A considerable portion of the year's work has been devoted to the lengthy task of summarizing back records in such a way that their analysis may be proceeded with ; and it is now possible to review the performance of the trees on all the major trials. Sufficient light has now been shed upon the problem of the relationship between the different manifestations of such tree characteristics as vigour and cropping, to show the exceedingly complex nature of the problem.

It is apparent that as any one measure cannot possibly give a complete picture of the vigour of a tree at any one time, the measurements to be taken must depend upon the nature and purpose of the experiment.

In the meantime the rapid increase in size of trees, to say nothing of heavy crops, has made labour saving schemes for taking records an imperative necessity. In consequence, a number of sampling methods are being tried out. Although it is very difficult to sample a tree for such quantitative characters as actual growth or fruiting, it seems probable that a very good idea of such qualitative characters as size of fruit, stoutness of wood, etc., may be obtained in this way.

The more intimate knowledge gained as a result of careful analysis of the records upon material of known history, has facilitated the progress of plot planning work and the better organisation of recording.

PUBLICATIONS DURING THE YEAR.

Rogers, W. S. ROOT SYSTEM AND TREE PERFORMANCE. Fruit Grower, 1929. **68**, 646.

Summary.

This article describes the East Malling Research Station Exhibit at the Imperial Fruit Show, 1929. The four ten-year-old Lane's Prince Albert trees shown demonstrate the wide range of vigour obtained by the use of different rootstocks. Rootstock effect on fruiting is also discussed. The excavated root systems of the trees, re-arranged in mid air, demonstrate position and spread of root system. This far exceeds the branch spread. Manuring round the trunk is inefficient.

Hatton, R. G., and *Rogers, W. S.* THE IMPORTANCE OF THE ROOT SYSTEM. Imperial Fruit Show leaflet, issued by the Empire Marketing Board (1929) and Journ. of Kent Farmers' Union, 1929. **26**, 120-122.

Summary.

The work here demonstrated shows how the grower after considering his soil, variety, purpose and other conditions can choose a rootstock for his trees which will give a definite standard of performance and help to attain his ultimate object. There is no best rootstock for all purposes, but the wide range available can suit a great variety of conditions. All tree fruits can be controlled in greater or less degree through the rootstock. Some aspects have already been reported on. Many aspects are still under detailed study at this Research Station, and queries and information on these matters are always welcome.

THE RELATIONSHIP BETWEEN THE EXPERIMENTAL AND THE DEMONSTRATION PLOT AND THEIR RELATIVE VALUE TO THE INVESTIGATOR, THE COUNTY OFFICER AND THE FRUIT GROWER.

By T. N. HOBLYN.

In these days of foreign competition and consequent low prices, it becomes more and more urgent for all who are trying to make a living as fruit growers and market gardeners, to produce the maximum amount of high quality produce at the lowest possible cost.

It does not need a statistician to point out that in many cases this ideal is a very long way from realisation. Even the most experienced grower finds year by year that there are problems confronting him for which no one can provide a solution. Indeed it is very patent that present day knowledge of horticulture, built up, as it has been, from experience and tradition, aided in the last twenty-five years by organised research, still contains many gaps. How are these gaps to be filled?

The Functions of the Research Station.

The principal organisations which exist at the present time for the elucidation of horticultural problems are the rapidly growing research stations. Their business is concerned primarily with the general principles of horticultural science and practice. For example, "What manurial constituents are essential for the proper growth and cropping of horticultural plants"? Here is a problem which needs the services of the plant chemist, the soil chemist, the plant physiologist, the research worker in the field, or as he has come to be termed, the *pomologist*, and finally the statistician, before the whole story can be told.

Just as in the various laboratories specialists are needed to work out the reactions in the soil and the response of the plant to the different manurial constituents, so the horticulturalist must be specially trained in the art of field experimentation, in order to observe the effect of the fertilisers on the plants growing under field conditions. Now before the research worker can lay down any principle of horticultural practice, although he knows full well that the principle may require modification or adaptation to particular circumstances, he must be absolutely certain that the fundamental principle itself is correct. Thus, if he wishes to lay down the fact that Nitrogen applications are necessary for the proper functioning of apple trees, although he may be well aware that certain soils already contain sufficient Nitrogen for the trees, he must make

quite certain that his general principle is true. It is obvious, therefore, that he must try out his effects under a number of different soil and seasonal conditions, for, if for example he were to experiment on one type of soil only, which already contained enough Nitrogen, he might come to a totally wrong conclusion.

Just as the experimenter has to contend with wide differences in soil or season, so within the scope of any one experiment which he may lay down, he has to estimate the effect of a number of local variations before he can be certain that the results of his experimental treatments are " significant." Now before considering what these variations consist of, it will be well to define clearly this term " significant."

Consider the form of two horses A. and B. If in a number of races A. had won, but on several occasions he had been beaten by B., it would be very difficult for the discriminating backer to make up his mind on which to put his money. Indeed he would say : " A. and B. are two equally good horses and it is merely a matter of chance which wins." If on the other hand A. had won nine times out of ten, he would have very good grounds for backing that horse to win again. In other words, in spite of the fact that B. had once beaten A., the odds would be heavily in favour of A. winning again, or A's performance was significantly better than that of B.

Variations in Horticultural Material.

Now just as horses have their on and off days, and upon their variability can their future performance with more or less certainty be foretold, so almost anything that can be measured (e.g., the size of a particular variety of black currant bush, the cropping of an apple tree under certain conditions), varies quite apart from accidental causes.

As a general rule, most measurable characters vary according to what is known as the normal Law of Errors. That is to say, if all the apples of certain trees are weighed individually, it will be found that there will be a large number whose weight is near the average, the numbers tailing off each side of this average, so that there are one or two very small and one or two very large.

In just the same way, the yields of the individual trees in a plantation will vary about the average quite apart from accidental causes of variation, such as injury to the trees by insect and fungus pests.

Thus the yields of eight adjacent trees of Lane's on No. IX. in a plantation at East Malling, whose average crop in ten years was 63 lbs. per tree, were 63, 58, 65, 46, 65, 48, 83, 77 lbs., respectively.

Inseparable from this inherent variability in the trees themselves, there is a certain amount of variation which is due to a number of causes, which may or may not be avoided, by very careful management of the trees themselves. One of the chief of these causes in the past has been the influence on the trees

of seedling rootstocks. A great advance has been made in the last fifteen years by the standardization of the rootstocks in common use by the practice of vegetative propagation of clone material, and the consequent elimination of this disturbing factor. As an example of the variations which might have been encountered due to this factor, it is only necessary to point out that from an original collection of seventeen such " seedlings " at East Malling, at least four (when vegetatively multiplied) can be shown to induce widely differing behaviours in the growth and cropping of the trees " worked " upon them.

To quote the extremes, twenty trees of Lane's Prince Albert on No. XII. have averaged six times the amount of growth of a similar twenty trees on No. IX. in the first ten years of their lives (810 metres as against 136 metres), whereas in cropping, the trees on No. IX. produced 73 lbs. per tree as against 23 lbs. on No. XII. in the same period. An extreme instance may be cited from the Pruning Plot at East Malling, where a number of fourteen-year-old Early Victoria apple trees, grown upon Seedling French Crab, can be compared with similar trees on trade Paradise. Although, as one-year-olds, the trees had been carefully graded for size, those on Seedlings have exhibited a much greater amount of variation in growth and cropping compared with the series on vegetatively raised stocks. Whilst the lightest cropping tree on Crab produced only 146 lbs. of fruit in fourteen years, the heaviest cropping tree has had 1,437 lbs. or ten times as much. The greatest difference in cropping of the same series on Paradise was between tree No. 4, giving 174 lbs. and tree No. 7, giving 678 lbs. or about four times as much.

It is easy to see, from these figures, the difficulties which the research worker had to face in trying to show any but the largest differences due to contrasting treatments.

However, in spite of the great reduction in variation which has been achieved by the elimination of this disturbing factor, there still remains another factor which the research worker cannot get rid of, which is bound to have a marked influence upon his field experiments.

Variations due to Differences in Soil or other Positional Factors.

Not only do fruit soils differ widely in different parts of the country, but in any field or orchard marked variations in any particular type of soil occur and are often reflected in the crops grown on that field. Thus, in a plantation of Lane's Prince Albert apple at East Malling, eight trees on No. IX., quoted previously, in one part of the field, have given an average yield of 63 lbs. per tree in ten years. Fifty yards away another group of eight identical trees averaged 90 lbs. per tree. This difference, which is statistically significant, can only be attributed to a difference in position on the ground. Anyone who has seen the excavations on a near-by plot, and the variations in depth of an

otherwise apparently uniform soil, will be able to find a reason for this marked divergence.

Again, in a trial of Black Currants, six plots at one end of the field averaged 390 lbs. per plot in 1929, while another six similar plots averaged only 260 lbs. per plot. Here is a difference probably due in part to shelter, the first six being sheltered by the railway bank, while the others were in a more open position.

The Experimental Plot.

It has been said that the research worker must be absolutely certain of his general principles before he advises their application to horticultural problems. His field experiments must therefore be designed to elucidate the point in question. An " indication " or even a " good indication " is of no value to the grower and may be actually misleading ; and to the research worker himself it is merely a signal for further and more accurate experiments. Bearing in mind the variations to be found in all such experiments, it is obvious that not only must he try every means of reducing the avoidable errors in his material, but that he must also be able to estimate accurately the unavoidable errors, before he can be certain whether his result is significant or merely accidental.

The statistician has at his disposal certain mathematical formulæ by which he can estimate the amount of this variability and calculate the chances of repeating any given result under the same conditions, just as the bookmaker calculates the odds against a horse winning any particular race. In order, however, to use these formulæ legitimately, certain rules must be complied with.

(1) A sufficient *number* of samples of the behaviour of the variety under consideration must be observed in order to calculate its variability ; and it is obvious that the more variable that variety the greater is the number of samples necessary.

(2) For the estimate of the amount of variability to be *valid*, it is necessary that each of these samples should be selected at random from the whole population ; e.g., if it were desired to estimate the average crop and the variation in a " population," which consisted of an orchard of Beauty of Bath, grown under certain conditions upon a certain piece of ground, the position on the ground occupied by each sample tree selected for the required estimates, should be determined by a process of chance selection. Practically of course the whole population of trees, small plots, or whatever it is which is being sampled, is seldom present, only the samples of that hypothetical population being actually grown. However, it is none the less essential that the batches of samples from the different populations in an experiment should be distributed at random on the ground devoted to the trial.

To sum up, if it is desired to compare say, the cropping of four varieties of black currant, A., B., C., D., a sufficient number of small plots containing bushes of each of these four sorts must be grown, to estimate with reasonable precision the variability within the varieties; and in order that this estimate may be a valid one, the position of each small plot upon the ground must be determined by chance.

Now, the idea of replication has come to be more or less accepted during the last few years, although much remains to be learnt as to the number of such replications necessary, especially for horticultural experiments. The idea of randomization (i.e., the distribution of plots on the ground by chance, as opposed to a systematic arrangement) has been slower to be accepted however, and has met with considerable opposition from those who say that it is " all very well in theory, but quite impossible in practice." It should be clearly understood however, that not only is this condition perfectly practicable under field conditions (given the time and labour necessary for any experimental purposes at all), but also that, as the famous statistician who writes under the pen name of " Student " so aptly puts it, " It is neglect of this rule in the past that has led to the estimate of the value of statistics, which is expressed in crescendo " Lies—damned lies—Statistics ! "

Now, these two rules may sound very formidable and it is obvious that many experiments which have been carried out in the past, are apparently condemned at once. This may or may not be the case. For example, many of the older experiments in this country, the results of which are now historic, were all conducted on a single plot basis, and no one will deny that very valuable results have been obtained therefrom. It must be remembered, however, that most of those results took many years to prove and in each of these years separate samples were obtained, since the plant dealt with was but an annual one. In horticulture, unfortunately, nearly all the plants dealt with are perennial and a sample of, say, the cropping of an apple tree, taken in one particular year, must always be dependent upon the previous history of the tree.

Even more than in agriculture, it is necessary therefore for horticultural workers to obtain a number of samples in one year, if any significant results are to be obtained at all. At the same time, it must be remembered that it is very unwise to publish any results that have only been obtained in one year, and that most experiments need to be repeated in a number of seasons before they can be regarded as giving conclusive results.

Again, it cannot be denied that the Rootstock Trials at East Malling, have given the most far reaching and conclusive results. Yet here there has been no attempt at randomization. In this case, however, the most intimate and detailed records have been taken upon individual trees, repeated a large number of times,

not only at East Malling, but also upon a number of different soils; also many of the differences found have been so great, that they hardly need statistical analysis to establish them. On the other hand many of the smaller differences (and among these are included the differences which are not really there at all), which are also important when turned into pounds, shillings and pence, are still unproved and now require a much more refined technique to establish or disprove them. Indeed, if the technique now in use had been developed twelve years ago, the same results could have been achieved with greater accuracy and a considerable saving of ground.

Anybody who has visited a research station during recent years, will realise the vast amount of labour entailed in the extensive and often complicated experiments necessary to overcome the difficulties which have been outlined above. It is sufficiently obvious that only at such institutes, properly equipped for the task, can they be carried out.

Extension Experiments or Test Plots.

It must be remembered however, that these institutes are necessarily limited to one particular area and that before the general principles elucidated at the station can be universally applied, a number of extension experiments, or " tests " as they have been termed, must be carried out in the particular localities concerned. For example a variety of black currant which does well in Kent may not be the best for Norfolk, or a fertiliser, which may be vitally important on a sandy loam, may be unnecessary on clay.

It must be clearly understood however that, although these tests are generally much simpler than the complicated trials at the research institutions, involving probably only two or three main issues (e.g., two or three varieties out of a dozen in the original trial), they must of necessity be no less accurately carried out, since the difficulties of variation still remain and the conditions are different.

Limitations of staff prevent the research stations from carrying out very many of these extension experiments and in default of a special organisation to supply the labour, they are bound to look to the county organisations to fill the gap.

Whether the county instructor, with his multitudinous duties, can find the time to carry out these tests, is a matter upon which the writer hesitates to express an opinion, but the fact remains that they are an essential part of horticultural research.

In the past, attempts have been made to get over the difficulty by combining these tests with the educational or demonstration plots laid out at county farms and elsewhere. So much time and money have been wasted in demonstrations and tests of this kind, as well as in trials laid down without any regard

to the proper technique of field experimentation, that it seems worth while, at this juncture, to give some account of modern methods of plot arrangement, and to describe some simple arrangements which may be used for the purpose of extension trials or tests.

First, however, it is necessary to be quite clear as to the difference between the Demonstration Plot and Experimental or Test Plots and to show why the two are wholly incompatible.

There must always be a sharp distinction between demonstration and experimental plots since the objects in view are so utterly different. An experimental plot is, as has been seen, a plot designed to yield new information or to confirm facts already suspected, but not definitely proved. In this category is of course included the test plot, which is merely a simpler type of experimental plot, used to test a result which has been proved beyond question elsewhere under new sets of conditions.

The demonstration plot on the other hand, is designed to show clearly facts, the essential truth of which, under the conditions prevailing, is already definitely proved.

Now it must be stated emphatically that not only is a good demonstration plot of no experimental value whatsoever, but also that a really sound experiment very seldom makes a good demonstration.

The Demonstration Plot.

The most desirable qualities in a demonstration plot may be summed up as follows :—

(*a*) *It should be simple* both in its teaching and in its design. A demonstration that is too complicated and which needs a lot of explanation is seldom convincing to the farmer. For example, whereas four representative varieties of the four main groups of Black Currant grown side by side would be a good demonstration, it would be merely confusing to include a number of subtypes as well. In order to be really convincing, the area devoted to each variety should also be fairly large.

(*b*) The results of two contrasting treatments or the difference between two varieties should be *absolutely clear cut*. For example, to try to demonstrate the results of Potash starvation on Worcester Pearmain would be unsatisfactory. The detrimental effect will be there and can be shown by measurements of crop, etc., but it is not nearly so obvious to the eye as in varieties such as Bramley's Seedling or Grenadier, both of which scorch readily.

(*c*) It should demonstrate *only one thing at a time*. Consider two plantations not so planned.

(1) Rootstock Effect and Pruning.

A demonstration designed to show the use which can be made of the various rootstocks, on which are superimposed comparative methods of pruning. Since it is now known that different varieties require different pruning treatments and that, further, the same variety cannot be pruned alike on, say, a vigorous and a dwarfing rootstock, if the pruning is varied on each combination of scion and stock, the results of the rootstock demonstration are masked and the plot at once becomes so complicated as to demonstrate nothing at all. Therefore, on such a plot it would be best to use only those pruning methods as are thought to be best suited to the purpose in view.

(2) Rootstock Effect and Manuring.

A plot devoted to a rootstock demonstration *must* be manured alike throughout, since, as soon as the fertiliser applications are varied, all kinds of differential effects are set up, which at once spoil the force of the original demonstration.

(*d*) Lastly, the point, which the demonstration is designed to show, should have been *proved conclusively elsewhere.* Now, there are a few, and only a few, outstanding points which have been proved up to the hilt by recent research.

Such outstanding results as the value of Potash applications on trees obviously suffering from Potash starvation, the proper usages of different rootstocks, the proper manuring of potatoes, are all good subjects for demonstration; but, in the writer's opinion, all those vague issues, such as " comparisons of new and unknown varieties or spraying materials with those of known merit," should be definitely relegated to the experimental plot, until more is known about them.

What other subjects are fit for demonstration at the present time, is a matter to be decided by the experts in the various branches of horticultural science. If however, anybody, before laying down a demonstration, would ask himself the question : " Am I absolutely assured of the essential truth of this point I am going to demonstrate, and will it be as convincing to the grower ? " (and resolutely forget the other question, " Is this plot going to pay " ?) then, in the writer's opinion, far more demonstrations would achieve their object, and, in the end, far less money would be wasted.

It will be readily conceded that there is little likelihood of such demonstration plots being of any value experimentally. It will be well therefore to describe briefly one or two arrangements, suitable for test plots, which, while conforming to the principles laid down above, are not very complicated in their lay out.

METHODS OF ARRANGEMENT SUITABLE FOR TEST PLOTS.

(1) *The Strip Method* (Fig. 1.)

This method, which has been much used in cereal trials, might to some extent be employed in variety trials of vegetables or small fruits, or even on certain large scale trials of apples, where two varieties or treatments are in question. The field is divided into a number of pairs of strips (see Fig. 1). These may be rows of carrots, strawberries (where runners are removed), raspberries, rows of trees under two spraying treatments or anything, provided the *row is taken as the unit* and can be harvested as a whole.

In each pair of strips the two varieties are grown side by side, but the position occupied by each variety is decided by the spin of a coin.

The method by which the significance of the results of such a trial is judged is very simple to anyone acquainted with the elements of statistics; the writer is however fully aware that there are many who are not included in this category.

When publishing results therefore, either give the *individual yields from each plot* or make use of someone whose job it is to work out these things. The statistical section at East Malling is only too willing to assist anyone who is in any difficulty, either in the lay out of plots or in the interpretation of results.

As regards the length of row necessary on a trial such as the above, there are so many crops to which the method can be applied, that it is impossible to generalize; a minimum of eight pairs of strips should be laid down and the rows should be as long as possible.

(2) *The Method of Randomized Blocks.*

If the number of varieties or treatments is increased from two, to three or more, the method of "Randomized Blocks" in its simplest form is arrived at; and here it is necessary to digress in order to explain as briefly and simply as possible the theory on which this and another method to be described are based.

For the sake of argument consider a field of black currants on which a manurial trial is to be carried out. Before the manures are applied, there are two main sources of variation in the field:

(*a*) That due to the heterogeneity of the soil or differences in position on the ground.

(*b*) That due to the inherent variability of the bushes.

These two sources of variability together make up a total amount of variation for the field which can be estimated. If now the field is divided into four blocks, the variation between the total yields of these four areas can be calculated, giving an estimate of the variation due to differences in soil, etc., in

FIG. 1.

THE STRIP METHOD.

these four parts of the field. Subtracting this amount from the total, an estimate of the amount of variation inherent in the bushes, plus the remaining variation due to soil, and accidental causes is obtained.

Now apply the manurial treatments, and it is easy to see that at once the total variability of the field is increased, by a more or less amount accordingly as there are greater or lesser differences between the effects of the manures applied.

In planning an experiment therefore, the four blocks are still maintained (in order to estimate the soil variation) and the differently treated sub-plots are distributed at random on the field, but, with this proviso, that each treatment occurs once in each block. There are then four repetitions of each treatment, from which it is easy to calculate the amount of variation between differently treated sub-plots. If this amount of variation is significantly greater than that inherent in the material, then there must be significant differences between the results of the treatments and it is easy to find out what those differences are.

This is broadly the principle on which the method of Randomized Blocks is based and it will be readily understood that this method is capable of being used for a very large number of different kinds of experiment.

There are two ways of increasing the accuracy of the method. Firstly, of course, the field can be split up into a larger number of blocks, thus increasing the number of replications of each treatment.

This way is the best, but is more suitable for the research station with its special facilities. Secondly, to some extent, the accuracy can be improved by increasing the size of the sub-plots, e.g., using the best rogued material, where seven plots of strawberries, .008 of an acre (92 plants) would be necessary in order to show a 20 per cent. difference, only five plots would be needed if the size of plot were doubled. This latter way is certainly more extravagant in ground, but for the hard pressed County Instructor it is a much simpler way. It is therefore proposed to describe three examples of the use of this method, all of which might quite possibly be carried out outside a regular research station.

(i) *Royal Sovereign Strawberry.* "Strain and Time of Planting Experiment," planted at East Malling, Winter 1927-28 (Fig. 2.)
Treatments. Three strains, A., B. and C., each planted in Autumn and in Spring, giving six treatments in all.
Method of Arrangement. Six Randomized Blocks.
Size and description of sub-plot. Three rows of strawberries, 285 feet long (228 plants to a row).

(ii) "*Variety Trial of Black Currants.*" Planted at East Malling, February 1928 (Fig. 3).

FIG. 2.

ROYAL SOVEREIGN STRAWBERRY.

STRAIN AND TIME OF PLANTING EXPERIMENT. SIX RANDOMIZED BLOCKS.

A	C	B	A	C	B	B	C	A	C	A	B	A	C	B	B	A	C
SP.	AUT.	AUT.	AUT.	SP.	SP.	AUT.	SP.	SP.	AUT.	AUT.	SP.	SP.	SP.	AUT.	SP.	AUT.	AUT.

3 Strains: A, B, C. 2 Times of Planting: Spring and Autumn.

FIG. 3.

BLACK CURRANT VARIETY TRIAL.

SIX RANDOMIZED BLOCKS.

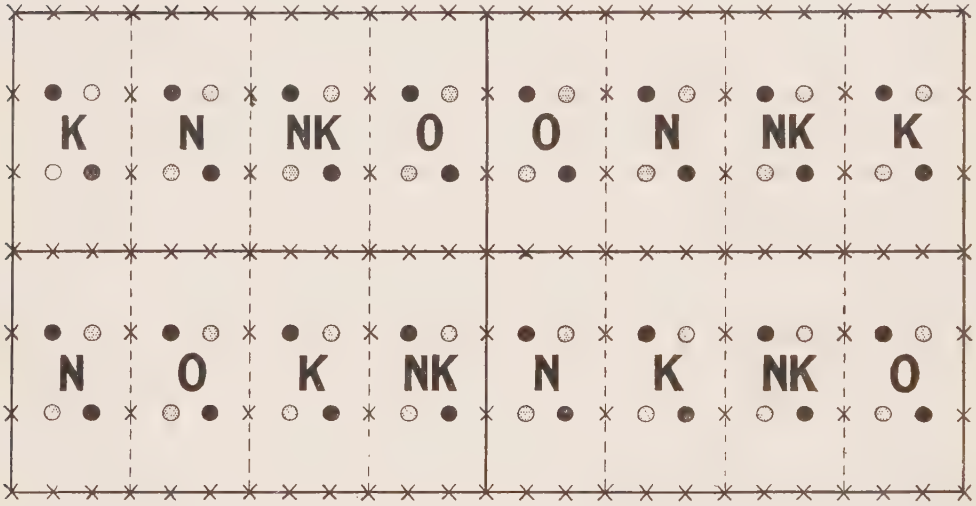
SEABROOK'S	GOLIATH	SEABROOK'S
FRENCH	SDG "C"	SDG "A"
SDG "A"	SEABROOK'S	SDG "B"
BALDWIN	SDG "A"	BOSKOOP
SDG "B"	BOSKOOP	SDG "C"
BOSKOOP	BALDWIN	FRENCH
GOLIATH	SDG "B"	GOLIATH
SDG "C"	FRENCH	BALDWIN
BOSKOOP	SDG "C"	SEABROOK'S
SDG "B"	SDG "B"	SDG "A"
SEABROOK'S	BOSKOOP	FRENCH
SDG "A"	SDG "A"	SDG "C"
SDG "C"	FRENCH	BOSKOOP
FRENCH	SEABROOK'S	BALDWIN
GOLIATH	GOLIATH	GOLIATH
BALDWIN	BALDWIN	SDG "B"

N.B.—Each Plot consists of 15 Bushes.

Varieties. Baldwin, Boskoop, Goliath, French and Seabrook's compared with three new Seedlings.
Method of arrangement. Six Randomized Blocks.
Size and description of sub-plot. Sixteen bushes in a row.

(iii) *Manurial Trial of Apples.* Planned for Mr. R. Hart, planted Spring, 1928 (Fig. 4.).

FIG. 4. APPLE MANURIAL TRIAL.
COX'S ORANGE PIPPIN ON ROOTSTOCK Nos. II AND IX.
FOUR RANDOMIZED BLOCKS.



◍ = 1 tree Cox on No. II. ● = 1 tree Cox on No. IX. X = Guard tree.
N = Nitrogen. K = Potash. NK = Nitrogen and Potash. O = Nothing.

Treatments. Nothing, Nitrogen, Potash, Nitrogen and Potash.
Method. Four Randomized Blocks.
Size and Description of sub-plot. Four trees of Cox's Orange Pippin, two on Doucin, No. II and two on Metz, No. IX.—each sub-plot surrounded by a guard row.

(3) *The Latin Square.*

Thirdly, it is necessary to describe one further refinement of this form of trial, the *Latin Square.* Now this, the most accurate form of trial now developed, will be of particular value as a test plot provided the number of treatments or varieties under test is rigorously curtailed.

In its simplest form, it consists of four replications of each of four varieties. These sixteen sub-plots are arranged in the form of a square in such a way that each of the four varieties occurs once and once only in each row and in each

column, the actual position occupied by each in the row or column, being determined by chance (See Fig. 5).

The advantage of this method is that the soil variation can be calculated in two directions and thus with much greater precision. Where six replications of four treatments would be necessary in the former method, if a Latin Square is used, the number of replications could be reduced to four, without, in all probability, an appreciable loss of accuracy.

The only disadvantage of the method is the fact that there must always be the same number of replications as there are treatments. Thus whereas with four treatments there are sixteen plots, with eight there must be sixty-four and with ten, a hundred. With up to six treatments or varieties, therefore, the Latin Square arrangement might be used with advantage, but, if the number of issues in the experiment must be increased beyond this point, then the method of randomized blocks should be used.

Example: Black Currant Variety Trial.

Method: 4 by 4 Latin Square (Fig. 5).

The example given here is taken from a much larger trial which consists of six such Latin Squares. If only one square is used, the size of each plot should be greatly increased, i.e., certainly to not less than sixteen bushes in a plot and if the material is very variable, to a good many more.

The methods described above make it quite clear that, even when reduced to the simplest form, any form of experiment must require careful thought both in its lay out and in its execution. The weighing and recording of small plots is a task which requires supervision and it is obvious that the County Instructor cannot be expected to carry out nearly as many such trials as are necessary to cover the differing conditions in the whole of his area. It remains, therefore, with the grower himself to complete the picture under his own conditions.

Now, in the writer's opinion, it is not the business of the grower to carry out experiments or tests, as they are understood at the present day. At the critical time when the test plots require attention, he is certain to be too busy to attend to them.

Knowing the difficulties with which the research worker has to contend, he will realise that it is fatal to draw any conclusions from small scale experiments (a few hills of a new hop, half a dozen bushes of a new black currant, a couple of rows of a new strawberry) carried out generally, without controls or any allowance for soil or seasonal variations.

Chandler describes growers' experiments in America as follows:— "Usually a commercial grower does not compare different practices at the same time in the same orchard. Rather, he has in mind an impression as to what an orchard should yield; and when a new practice, such as the application of

Fig. 5.

BLACK CURRANT VARIETY TRIAL.

4 × 4 Latin Square.

Taylor's O O O O	Boskoop O O O O	Davison's O O O O	Baldwin O O O O
Davison's O O O O	Baldwin O O O O	Taylor's O O O O	Boskoop O O O O
Baldwin O O O O	Taylor's O O O O	Boskoop O O O O	Davison's O O O O
Boskoop O O O O	Davison's O O O O	Baldwin O O O O	Taylor's O O O O

O = One Bush. Each Plot consists of 4 Bushes.

some new fertilizer is tried in his or his neighbour's orchard he compares the result with his idea of what the orchard should yield without the change in practice."

What the Grower can do.

The fruit grower, however, who wishes to obtain the maximum benefit from research, can take as a model the demonstration plot as it has been here defined.

If he will lay down such plots on his own land and keep them there for a number of seasons, he will be not only adding to his own knowledge, but helping the research worker and county instructor at the same time. If, for example, he has been growing Boskoop black currant for a number of years, and he is told that Baldwin is likely to yield him more to the acre, let him plant up half an acre of Baldwin and half an acre of Boskoop at the same time and grow them side by side under identical conditions for at least three years, before he makes up his mind as to which will suit him best.

To sum up, the research worker alone cannot hope to throw light upon all the details and modifications of horticultural practices. He must in the main confine himself to fundamentals. The county organisations and the fruit growers must of necessity contribute their share ; but at the same time it will be well to keep in mind the age old axiom " A thing which is worth doing at all is worth doing well. If it can't be done well, it is better left alone."

Summary.

(1) The variations to be found in horticultural crops and their effects upon modern methods of field experimentation are described.

(2) It is affirmed that Extension Trials or " Tests " carried out outside the regular research stations are an essential part of horticultural research.

(3) The difference between the demonstration plot and the experiment or test is defined.

(4) Some not very complicated arrangements of plots, suitable for such tests, are described.

(5) It is pointed out that the fruit grower cannot be expected to carry out experiments, but that demonstrations on his own farm will be of great assistance to him in obtaining the maximum benefit from the results of recent research.

Part II

Physiology

Part II

PHYSIOLOGY

Vegetative Propagation.

Trials have been continued of the influence of external conditions upon the rooting of cuttings of varieties difficult to propagate. Attention is still being concentrated on soil and atmospheric moisture and, although preliminary experiments with shelters have not given good results, closer regulation of soil moisture is promising.

Influence of Rootstock on Leaf Relations of Apple Trees.

The weekly increase in leaf area of maiden trees of Worcester Pearmain on the four stocks I, II, IX and XII has been investigated, and this work will be continued and extended next year.

In this investigation the smaller leaves were measured by the method of standard forms described in last year's report. A new method has been developed and used for the measurement of larger leaves with greater speed and without loss of accuracy. The leaf is gripped under a sheet of glass ruled in squares $(.5 \text{ cm.})^2$. By counting the number of squares in the portion of the glass directly over the leaf, the area of the leaf can be determined with a reasonable degree of accuracy.

Growth.

Stem Diameter and New Shoot Growth.

A report on this subject is ready for publication. It has been shown how the differences in stem diameter of plants subjected to different methods of pruning are arrived at, the amount of increase in diameter depending on proximity to growing shoots and apparently also upon the type of shoot-growth made.

Seasonal Course of Root and Shoot Development in Apple Stocks.

Although considerable knowledge has accumulated as to the total amount of stem growth made during the year by fruit trees, little is known as yet about the variations in this rate of growth at different seasons of the year, or of the effect of local climatic conditions upon this rate. With regard to root growth still less is known. It is not known for certain at what season the roots grow fastest, at what time they become dormant, how long they remain dormant, or indeed, if they become completely dormant at all.

A knowledge of the seasons of maximum and minimum growth and of their relation to local climatic conditions will obviously be of value in connection with all fruit studies.

To fill this gap in our knowledge, preliminary investigations have been begun this year on one-year-old trees of Stock No. XIII. Samples of trees have been harvested at intervals of about a month, from spring onwards, and the increments in weight of the various organs determined by taking the dry weights of the leaves, shoots and roots.

This work will be continued, and will be extended to older trees.

Excavation of Root Systems.

In collaboration with the Pomological Department, the investigation of the root system of older trees has been continued. For full report see Pomological Section.

Analysis of Rootstock Influence and the Reciprocal Effect of Scion upon Stock.

In collaboration with Pomological Section. *Vide* Pomology A.b.

Part III

Biochemistry

Part III

BIOCHEMISTRY

Stock Influence.

During the past year the spectrographic survey of the elements occurring in apple tree ash has been somewhat extended and progress has been made with an analytical method which it is hoped will be applicable to most of them.

Elements so far detected by spectrographic means, arranged roughly in order of the intensity of their lines are:—Calcium, magnesium, potassium, sodium, aluminium, iron, manganese, silicon, strontium, barium, lead, lithium, copper, vanadium, nickel, titanium, chromium, tin, molybdenum, silver.

Reference was made in the last year's report to the fact that though most of these elements appeared to be more or less uniformly distributed throughout the tissues of the plant, certain of them, in young trees, at least, were more abundant in the lower than in the higher woody parts. Thus the minute amount of lead detected seemed to be restricted to the root wood and the aluminium lines became weaker as the woody parts were ascended. To them must now be added molybdenum which has been detected in woody parts of stock No. IX. below graft level but which appeared to be absent from all parts above graft level, and also from the bark below graft level.

As far as can be judged from analyses of the roots of ten trees on stock No. XII. and nine trees on stock No. IX., growing in two parallel rows, this element was absent from stock No. XII. and was probably a fairly constant constituent of stock No. IX. Any more definite conclusion must await the perfecting of the quantitative method, for technical difficulties in the spectrographic method when applied to molybdenum render it unsuitable for the further examination of the distribution of this element, especially in view of the small amounts of material available.

The results of the spectrographic tests as a whole suggest that there are sufficient differences in distribution of the ash constituents, particularly these occurring in minute amount, both when different parts of the same tree, and when corresponding parts of different stocks, are compared, to justify a careful study of them by quantitative methods.

It is hoped that most of the technical difficulties inherent in the physico-chemical method which is being adapted for the quantitative determination of most of the ash constituents have now been overcome and that the method will be yielding results early in the New Year.

Insecticidal and Fungicidal Action of Sulphur.

As a result of work carried out at Rothamsted, thiosulphuric acid was suggested as the compound most likely to be responsible for the fungicidal action of sulphur towards Wart Disease of potatoes, but the existence of this acid in a free state is commonly denied. Recently modifications of the methods of others have led to a proof of the existence of thiosulphuric acid in a free state and experiments defining its degree of stability have been carried out. The facts obtained support the idea that thiosulphuric acid was the cause of the toxicities both of a series of solutions tested in the laboratory and of sulphur in the field.

An opportunity of extending this work to other fungi in the laboratory has not yet arisen and preliminary tests in the field carried out in collaboration with the mycological section have so far yielded inconclusive results.

Arising out of observations made some years ago attempts have been made, in collaboration with the entomological section, to increase the efficiency of methods of application of elementary sulphur. Working with red spider, it has been found possible to reduce considerably the amount of sulphur and the relatively resistant greenhouse red spider has been killed on Leveller gooseberry (perhaps the most sensitive variety to sulphur injury) without causing leaf drop. The results hold out some hope of eventual practical applications.

Part IV

Plant Pathology
Mycology and Bacteriology

Part IV

PLANT PATHOLOGY
MYCOLOGY AND BACTERIOLOGY

1. Crown-gall.

Inoculation experiments have been carried out on young trees of two apple stocks which have shown different degrees of susceptibility in the field, to ascertain whether the differences are observable under more controlled conditions. The trees were examined during the winter and considerable differences in the degree of infection was shown by the two varieties.

An examination has been made of young apple trees (of two different stocks) which had been grown for two years on plots receiving different manurial treatment. No significant difference in the number and size of the galls on trees from the various plots could be detected.

2. Brown Rot Diseases.

Inoculations on pear flowers have been continued using a strain of *Sclerotinia cinerea* obtained from cherry. Positive results were obtained. These experiments together with those carried out in 1928 offer conclusive proof that *Sclerotinia cinerea* forma *pruni*, as found on plums and cherries, can cause a Blossom Wilt of Fertility pear trees.

Inoculation experiments have been carried out to ascertain whether strains of *S. cinerea* from plum, sweet cherry and morello cherry respectively, can each infect the other hosts. The results obtained in 1929 show that *S. cinerea* from plum and sweet cherry is able to infect the flowers of the morello cherry.

3. Effect of Rootstock on the Susceptibility of the Scion.

Further observations taken on the trial plot of Cox's Orange Pippin apples continue to confirm those of previous years, in that the rootstock influences to some extent the susceptibility of the scion variety to Apple Scab and Apple Mildew. There is lack of conformity in the results for some stocks in different years, but the following data are more consistently obtained :—Cox's Orange Pippin is more susceptible (*a*) to scab on the twigs when worked on Malling Nos. I., IX., IV., XVI. respectively, than on Nos. XV., XIII. and III. respectively, (*b*) to scab on the leaves when on Nos. I., V., IX., than on Nos. XV., XIII., IV., (*c*) to scab on the fruit when on Nos. IX., I., than on XIII. The same variety

is more susceptible to mildew on the twigs when worked on Nos. I., II. and X. respectively than on Nos. XV., IV., XVI. respectively.

4. The Pathology of the Raspberry.

(1) *Blue Stripe Wilt.*

Previous observations and experiments have indicated that the intensity of attack of this disease on the canes of an infected stool is probably influenced to a large degree by external conditions such as temperature, humidity, etc.

This year, therefore, an experiment was carried out to determine whether the degree of parasitism of the causal organism artificially introduced into healthy plants could be modified by placing the plants under different conditions of temperature and humidity.

The results obtained indicate that the degree of parasitism can be modified by changing the environment but further work is necessary to determine the influence of specific factors.

(2) *The Control of Cane Spot of Raspberry (Anthracnose) by Spraying.*

The full results of the spraying trial against this disease carried out in 1928 are now available and indicate that although, as mentioned in the previous report the use of *Lime Sulphur* gave a better control of the spot lesions than *Bordeaux Mixture*, the effect of the Lime Sulphur on the canes was such as to cause a considerable reduction of the crop of 1928 and 1929 and a reduction in vigour of the new cane of 1928. It is hoped to plan a confirmatory trial using these two sprays, when sufficient mosaic-free cane is available. Meanwhile as *Bordeaux Mixture* has consistently given a good control of the disease without a trace of injury to the cane, this spray is recommended in preference to Lime Sulphur.

(3) *Raspberry Cane Blight.*

A serious outbreak of a disease in a plantation of *Bath's Perfection* was investigated early in the season.

A fungus associated with lesions on the affected cane was isolated and has been proved by artificial inoculation to be the cause of the disease. The fungus answers closely to description of *Coniothyrium fuckelii* the cause, in America, of a disease known as *Cane Blight.*

Subsequently, specimens of canes of other varieties of raspberry with similar symptoms were received.

Associated with the infected canes in many cases was the Cane Midge (*Thomasiniana theobaldi*). The lesions on canes provisionally ascribed to this midge are very similar to those caused by the fungus. It is proposed, in collaboration with the Entomological Section, to carry out infection experiments

to determine the part played by the fungus and by the midge in the production of the symptoms observed.

(4) *Other fungi associated with diseased Raspberry Canes.*

Inoculations with the following fungi have been carried out :—

Botrytis sp.
Cryptosporium minimum.
Microthyriella rubi.

The *Botrytis* sp. was associated with a very serious attack on *Lloyd George* canes in the Midlands in the summer of 1927. The inoculations have shown that this fungus is strongly parasitic on raspberry canes.

Cryptosporium minimum has been shown to be parasitic to a small degree.

The effect of *Microthyriella rubi* on the inoculated canes was negligible.

(5) *Raspberry Mosaic.*

(*a*) *Experiments in Artificial Transmission.*

Results of grafting experiments carried out in 1928 can be briefly summarized as follows :—

(i) The disease can be transmitted to healthy plants by a method of "bark grafting" which has great advantages compared with the method of cleft-grafting, although transmission by the latter method is much more rapid.

(ii) Evidence is provided that there are two distinct forms of mosaic with distinct symptoms within the variety *Baumforth Seedling B.*

(iii) There is evidence that when diseased shoots of certain highly susceptible varieties are grafted on to the moderately resistant variety *Baumforth Seedling B.* the apparent resistance breaks down.

(*b*) *Field Experiments.*

(i) As indicated in the previous report, a plot for raising mosaic free stock of certain commercial varieties was planted up in the autumn of 1927-28. Periodic inspections of this plot have been carried out during 1928 and 1929, and stools with definite symptoms, or suspicious in the least degree, were removed and destroyed. During 1929 only a very small number of diseased stools were found and a stock of mosaic free canes of certain varieties is now available for experimental purposes. It is hoped to extend this plot as material becomes available.

(ii) The field experiment on the control of mosaic in the variety *Lloyd George* has been continued.

A survey of the plot was made twice during 1929 and has provided interesting information on the mode of spread of the disease and on the possibility of controlling the disease in a commercial plantation by systematic roguing.

(iii) Further notes have been taken on the incidence of the disease on varieties in the Research Station collection. Considerable data are now available on the relative susceptibility of a large and comprehensive range of varieties.

5. Bacteriosis of Plum and Cherry Trees.

Cultural and infection studies of the organisms causing bacterial diseases in plum and cherry trees have been continued.

The distribution of Bacterial Canker is being investigated by means of visits to districts where the disease occurs and by the examination of specimens received from various localities. A survey of certain districts in Kent and Worcestershire was made in 1929.

Inoculations with the bacterial canker organism of plum trees have been made monthly to ascertain when infection of the stem takes place. It has been found that infection of the stem occurs more readily in autumn and winter than in spring and summer.

Experiments have been continued to determine whether the leaf-spot phase of the disease can be controlled by spraying.

6. Walnut Bacterial Blight.

The results of further cultural tests applied to the bacterium causing leaf-spots and stem lesions of walnut at East Malling have shown that it is identical with *Pseudomonas juglandis*, the Bacterial Blight organism of California.

7. Apple Spraying Field Trials.

The spraying trials for the control of Apple Scab and Apple Mildew on Cox's Orange Pippin have been continued and a small preliminary trial of various sulphur dusts has been made. The main indications from the trials up to the present are as follows:

Apple Scab on Twigs, Leaves and Fruit.

Three applications of Bordeaux Mixture, one just before and two after blossoming have given the best control of scab, though on this variety the spray is quite unsafe to use. Three similar applications of lime-sulphur have also given very good control and the spray is safe to use at a strength of 1-30 before and 1-100 after blossoming. The pre-blossoming application is very important and checks the disease considerably even when not followed by post-blossoming applications. The latter, without a pre-blossoming application have also given good control.

Two post-blossoming applications of lime-sulphur (1-150) and Colloidal Sulphur respectively, have given slight control.

Apple Mildew on Twigs.

The disease has best been checked by three applications of lime-sulphur, one before and two after blossoming. Two applications alone after blossoming, have also checked the disease, but indications of control by a pre-blossoming application only, are slight. Bordeaux mixture, while checking the disease somewhat, has been much less efficient than lime-sulphur. Two post-blossoming applications of lime-sulphur (1-150) and Colloidal sulphur respectively, have proved of little value.

Spray Injury.

Observations continue to reveal the harmful nature of Bordeaux Mixture on Cox's Orange Pippin, even when applied before blossoming only. The injury takes the form of severe fruit russeting and moderate leaf scorching. The use of hydrated lime in a Bordeaux Mixture of formula 8-12-100 has considerably accentuated this injury in 1929. Lime-sulphur used at the strengths given above appears to be quite safe to use. Spraying experiments on the variety Stirling Castle were discontinued in 1929 owing to the excessive injury caused in previous years by the sulphur preparations used.

8. Blister Disease of Apples.

Further examination of russeted apples and blistered twigs in 1929 has again revealed the widespread distribution of a fungus morphologically identical with *Coniothecium chomatosporum* Corda, the organism in all cases being closely associated with the above symptoms. Further work will be done in an endeavour to ascertain whether the fungus is responsible for the injury, and measures of control will be investigated.

PUBLICATION DURING THE YEAR.

Wormald, H. SOME DISEASES OF FRUIT TREES. Essex County Farmers' Union Year Book and Ann. Rep. 1929. 279-293.

Summary.

In this article those methods are reviewed which recent advances in our knowledge of plant protection have shown to be most likely to give good results against the more destructive fungous, bacterial and virus diseases of fruit trees in Britain.

APPLE SCAB AT EAST MALLING.

By M. H. MOORE.

The subject of Apple Scab has been under investigation at this station for the past three years chiefly from the point of view of its incidence and control, and quite early in the investigation it was evident that the problem is not a simple one. The control of the disease is not merely a matter of mixing up a spray in a tank, applying it to the trees and hoping for the best. One is not justified in hoping for the best without due consideration of the factors upon which successful control of scab appears to depend very intimately.

It is intended, in the present paper, to review some of these factors, and to that end the main results obtained at East Malling up to the present will be briefly indicated.

The spraying experiments have been carried out chiefly on one variety, Cox's Orange Pippin, which is very susceptible to scab, and is also a difficult variety to spray with any degree of success because it is so very liable to injury in some form, such as leaf scorch, defoliation, fruit russeting and fruit drop.

An attempt has been made to carry out the work having in view the observation of detail, in the hope that by this means indications would be forthcoming as to the why and the wherefore of certain phenomena, thus leading the specialized and localized study of conditions on the one variety into possible channels of broader application. It is necessary to emphasize that the results shown on Cox's Orange Pippin at East Malling are not necessarily those that will be obtained elsewhere. In fact, data have been obtained which indicate the very reasons why those results *should* differ, in many cases, from those obtained elsewhere.

1. Time of Application.

From the outset efforts have been concentrated on determining the importance of the time of application of sprays. In order to do this some trees have received a pre-blossom spray only; others have been given two post-blossom applications, and others have had all three. Bordeaux mixture, lime-sulphur and colloidal sulphur have been the principal fungicides used and lead arsenate paste, at 4 lb. per 100 gallons before, and 3 lb. per 100 gallons after blossoming has been incorporated with most of these in order to keep caterpillar attacks in check so that they should not interfere with the main trial. Bordeaux mixture has been applied at 8 : 8 : 100 before blossoming, and at 8 : 25 : 100 (burnt lime) afterwards, except in 1929, when hydrated lime was used and the

[*J. Amos, photo.*

FIG. 1.

Stage for application of "pink-bud" spray.

[*J. Amos, photo.*

FIG. 2.

Petal fall. Stage for application of first post-blossom spray.

formula became 8 : 12 : 100 all through. Lime-sulphur has been tested at 1 : 30 before blossoming and 1 : 100 afterwards, while colloidal sulphur at 4 lb. per 100 gallons has been applied twice after blossoming only.

The pre-blossom spray has been given at the "pink-bud" stage (see Fig. I.); the first post-blossom application at petal fall (see Fig. II.), and the second post-blossom three weeks later. All treatment apart from spraying has been the same on all trees.

Detailed records of scab infection have been taken on the young shoots, on the leaves and on the fruit, and the effect of the sprays has been gauged from an interpretation of these data.

Briefly, the main results are these: Bordeaux mixture has proved to be the best fungicide to use as a control measure but on this particular variety (Cox) it is quite unsafe, causing fairly severe leaf scorch, and very severe fruit russeting *even when applied before blossoming only*. When one application only has been given, in the "pink-bud" stage, Bordeaux mixture has not proved to be definitely superior to lime-sulphur, but on account of the susceptibility of Cox's Orange Pippin to sulphur injury after blossoming, lime-sulphur has had to be weakened in strength to 1 : 100, and this has undoubtedly made it less effective. Very good control has been shown by lime-sulphur and arsenate when all three applications were given, and there has been no damage to the fruit. This schedule is therefore recommended for Cox's Orange Pippin. The efficacy of the spray is undoubtedly largely due to the beneficial effect of the pre-blossom application, and it is this point which calls for special emphasis.

The results show that the critical period for scab development was in the early stages of the seasonal growth of the trees, i.e., approximately coincident with blossoming time. Where the pre-blossom spray was omitted, and the weather was favourable to scab development at that time, the disease had so far got "under way" that by the time the post-blossom applications were given, their chances of checking infection were considerably prejudiced. Colloidal sulphur by itself after blossoming has not proved very effective, though were it preceded by a thorough application of lime-sulphur at the "pink" stage, it would probably be able to carry on fairly effectively the foundation of control laid by the pre-blossom application, where conditions would not allow of after-blossom applications of lime-sulphur.

2. The Seasonal Factor.

Undoubtedly the seasonal factor plays a great part in the successful control of scab. The contrasting results obtained here in 1927, 1928 and 1929 indicate this point fairly clearly. It will be recalled that the summer of 1927 was extremely wet and sunless. The summers of 1928 and 1929 were just the reverse. Yet in 1927 there was surprisingly little infection by scab on the experimental

spraying plot, while in 1928 and 1929 the control trees were heavily infected by the end of the respective seasons.

This is accounted for by the weather in late April and May. In 1927, that period was very dry and sunny, scab development was checked, *and the pre-blossom application showed very little control in that year* because infection on the control trees was relatively slight. In 1928, when that period was wet, the disease was rampant early, and very good control was given by a pre-blossom application alone. The importance of a good foundation of protection in the critical period is thus evident.

Though 1929 was an abnormal drought year, unsprayed control trees were quite heavily infected at the end of the season. The disease appeared to be spreading slowly and surely, by accumulative effect on individual trees, in the height of the summer. There were extremely heavy dews on many nights during this period, and this fact is put forward as a possible explanation of the apparent anomaly.

Hence it is evident that it is not good policy to trust in the weather to control scab, because the very results which are accustomed to be taken for granted, given a certain set of weather conditions, do not necessarily follow.

It may be said that the weather is beyond control ; how can one know what to expect ? The best answer appears to be " Expect the worst and guard against it." Spraying can thus be regarded as a form of insurance of which the most important premium is the pre-blossom application!

3. Influence of Rootstock.

The trees on which these spraying experiments have been carried out are worked respectively on various Malling rootstocks, though the spraying trial has been arranged so that they do not interfere with the interpretation of results. This has proved to be very fortunate, for the results obtained up to the present show that there is undoubtedly an influence of stock on the degree of infection by Apple Scab on the scion variety. No detailed classification has been forthcoming from the three years' results, but, broadly speaking, one can say that Nos. I. and IX. induce susceptibility in Cox's Orange Pippin while Nos. XV. and XIII. induce resistance. It is sufficient at present, however, to know that there is a stock influence, for this opens up another possible reason why results in spraying are often so contradictory. It indicates, also, another of the factors which must be taken into consideration in the interpretation of results.

It is possible, in view of these results, for two growers whose farms are in close proximity to be growing the same variety under the same general conditions, and for one to be troubled by scab while the other's trees are moderately free from it. Though it is not necessarily the case, the answer to the problem may be " rootstock."

Having indicated how the number and time of application of sprays, the season, and the rootstock can all affect the problem of scab control, there is another possibly important factor to consider, and that is manuring.

4. Influence of Manuring.

A year's data have been taken on the fruit from two varieties—Bramleys Seedling and Worcester Pearmain, worked on various rootstocks. The trees of both varieties on one plot have received balanced manurial dressings since 1920 so far as the needs of the tree are known, while comparable trees on the other plot have had no manure during that period. The trees on *both* plots received two applications of lime-sulphur in 1929, one at 1 : 30 before blossoming and one at 1 : 100 after blossoming, as soon after petal fall as possible, yet, when the fruits were harvested and graded for scab, it was found that the spraying had effected a very good control on the manured plot, while on the "starved" plot the infections of scab were very heavy indeed, and control was negligible. Incidentally, a marked stock influence was also shown by these varieties, trees on some stocks being much more heavily infected than those of the same variety on other stocks.

It is necessary to emphasize at this point that these scab figures in connection with manuring have been obtained only in one year, so that at present it is not known how far the results may be bound up with seasonal conditions.

Enough has been said to indicate the possible importance of manurial treatment as a factor in the successful control of apple scab by spraying.

Several points have not been dealt with in this paper, such as the method of mixing the spray, the use or not of a spreader, the type of machine etc., though they are not therefore ruled out as factors influencing the result. It is essential in tackling a problem such as this to deal with one or two points of view at a time. No good purpose is served by trying to elucidate all the problems in one attempt. Some of the possible factors have not been considered, therefore, as the scope offered by the material available, and the time which the investigation would require, have not at present been forthcoming.

Summary.

The practical importance of the following points in their application to successful control of Apple Scab has been reviewed :—

1. The time of application of sprays. Special emphasis is laid on the value of the "pink-bud" application.
2. The seasonal factor.
3. The influence of rootstock.
4. The influence of manuring.

Part V

Entomology

Part V

ENTOMOLOGY

Spraying Trials against the Fruit Tree Red Spider.

Dormant Winter Washes.

Investigations in relation to the control of the Fruit Tree Red Spider have been continued in the laboratory. The results obtained confirm those of 1927. The lubricating engine oil, of declared consistency, and containing 2 per cent. active oil, destroyed 50 per cent. of the viable eggs of Red Spider. The white oil emulsion sprays applied at 1 and 4 per cent., were not toxic to the eggs of this mite.

Spring and Summer Washes.

Experiments were undertaken with a view to controlling the Fruit Tree Red Spider which occurs on plums, during the growing season.

Three sprays were tested under field conditions.

It was found that certain lime-sulphur preparations, applied as post blossom sprays, destroyed a high percentage of the mites and a commercial control was obtained.

The white oil emulsion sprays, and Bordeaux Mixture, which was applied as a combined acaricide and fungicide, proved to be of no value as a means of controlling this pest.

The life cycle of the Red Spider has been worked out, and a report has been published.

A number of natural enemies of the Red Spider have been observed. Details of these, and their possible connection with tar-distillate washes, have been published.

In co-operation with the Biochemical Section, preliminary investigations on the control of Red Spider have been undertaken in the laboratory. A study of the mode of action of sulphur in killing the mite has led to a notable increase in efficiency of sulphur when treated by a new method in the laboratory. The results are encouraging, but further tests will be necessary before the trials are conducted in the field.

It has been found possible to kill Red Spider on Leveller gooseberry, a sulphur shy plant, by the above sulphur treatment without causing any leaf drop.

Resistance of Different Rootstocks to Insect Attack.

This investigation has been mainly confined to a collection of layered apple stocks, raised from immune seedlings. It has been found that all these layered stocks have maintained the immunity of the parents, after continued infections, throughout the summer months.

Similarly, stocks raised from plants known to be resistant to the attack of apple aphis, exhibit the same degree of resistance as the original plants selected for this character five years ago.

Apple Sawfly.

Further details of the life-cycle of the Apple Sawfly have been obtained. It has been established that the larvæ may burrow into the soil to a considerable depth. This appears to depend upon the soil formation. At East Malling many larvæ have been found 30 inches below the surface.

Control of Black Currant Gall Mites.

Big-Bud on Black Currants.

Preliminary spraying trials have been carried out to determine whether it is possible to obtain a still greater measure of control of big-bud by means of a post blossom non-scorching spray, in place of the lime-sulphur at present used.

Gall Mites on Red Currants.

Preliminary field trials have been undertaken to test the value of lime-sulphur as a means of control.

While it has been established that lime-sulphur will destroy the mites, it has not as yet been possible to determine the ideal period for its application.

Systematic Study of Gall Mites.

The general systematic work on the group *Eriophyidæ* is being continued, and two more new species from abroad have been described.

The species of Gall Mites which occur on cultivated nuts in this country have been worked out, and a report is ready for publication. The Common Nut Gall Mite (*Eriophyes avellanæ* Nal.) has been causing considerable damage to nut bushes by destroying the female flowers. The habits of this mite have been studied with a view to its control. Certain species of Gall Mites that occur on plum trees have also been studied.

Plum Leaf Hoppers.

Certain aspects of the life-history of two species of plum leaf hoppers have been investigated and it has been found that these insects spend the winter in the

egg state. The eggs are deposited in the stems and branches of the plum trees during the autumn. The leaf hoppers emerge in the spring. An account of these observations has been published.

Raspberry and Loganberry Beetle (*Byturus tomentosus* F.).

Further observations have been made on the life history of this pest and a spraying trial conducted on a plantation of loganberries. From this trial it was found that although the pest could be successfully controlled by means of lead arsenate spraying, berries from plants so treated contained a dangerous amount of arsenic. It has been concluded therefore that the use of lead arsenate must be ruled out. A Derris Root preparation, an alcoholic extract of Pyrethrum and a white oil emulsion (this emulsion was used as a contact wash against the eggs) have also been tried but so far without success. A progress report has been prepared.

Insect Transmission of Raspberry Mosaic.

Work on this subject has been continued as well as present facilities permit. The raspberry aphis *Amphorophora rubi* has been used in cage inoculations, and the body juices of *A. rubi, Lygus pabulinus, L. pratensis, Capsus ruber,* and certain leaf hoppers (previously fed on Mosaic tissues) have been used in scratch inoculations in collaboration with the Mycological Section, but the results will not be obvious for at least another season.

Other Raspberry Pests.

Further observations have been made on the Cane Midge (*Thomasiniana theobaldi* Barnes) and investigations are in progress jointly with the Mycological Section to determine the relations between the injury caused by this midge and by the fungal disease known as Cane Blight.

Capsidæ.

A systematic study of this group has been continued with special reference to the species of economic importance such as *Calocoris fulvomaculatus*, the Shy Bug of Hops, *Lygus spinolæ*, also on Hops, *L. pratensis* and *Plesiocoris rugicollis*.

It has been determined and confirmed that the Hop acts as a summer host to the Common Green Capsid, *L. pabulinus*.

Alcoholic, aqueous and oil extracts of Pyrethrum were tested and found to be toxic to the nymphs of *L. pabulinus*.

Observations have been made on the methods of egg-laying and several species have been found to lay their eggs in wooden posts such as fence posts and hop-poles.

PUBLICATIONS DURING THE YEAR.

Massee, A. M. A NEW ERIOPHYID MITE ON BLACK CURRANT. The Annals and Mag. of Nat. Hist., Ser. 10. (Feb., 1929), **3**, 213.

SUMMARY.

A systematic description of a new species of Gall Mite (*Anthocoptes ribis* sp.n.) of black currant is given.

Steer, W. THE EGGS OF SOME *HEMIPTERA-HETEROPTERA*. The Entomologists' Monthly Mag. (Feb., 1929), **65**, 34-38.

SUMMARY.

The eggs of *Calocoris norvegicus* Gmel., *C. fulvomaculatus* De Geer, and *Nabis apterus* F. are described. The eggs of *norvegicus* are laid in fence posts and those of the other species in hop-poles.

Massee, A. M. THE OCCURRENCE OF *GNORIMUS NOBILIS* L. IN KENT. The Entomologists' Monthly Mag. (April, 1929), **65**, 93.

SUMMARY.

The occurrence of this rare beetle in the larval stage in old plum trees is recorded from two localities in Kent.

Steer, W. NOTE ON *ANTHOCORIS NEMORUM* L. (*HEMIPTERA-ANTHOCORIDÆ*). The Entomologists' Monthly Mag. (May, 1929), **65**, 103-104.

SUMMARY.

The habits of this bug are described. It preys extensively on red spiders and is possibly adversely affected by the use of tar-distillate winter washes.

Steer, W. CAPSIDÆ FOUND ON THE GENUS RUBUS. The Entomologist (May, 1929), **62**, 101-108.

SUMMARY.

A list of the species of Capsids found on Raspberries, Loganberries and related plants, with notes on the life-histories and habits of some of them.

Massee, A. M. NOTE ON THE APPLE BLOSSOM WEEVIL. Gardeners' Chronicle (May, 1929) (3rd Series), **85**, 393.

SUMMARY.

Observations show that the Apple Blossom Weevil feeds on the apple foliage prior to the oviposition period. The damage caused by the weevil is sometimes very considerable. Feeding takes place mainly at night.

Massee, A. M., and *Steer, W.* TAR-DISTILLATE WASHES AND RED SPIDER. Journ. of Min. of Agric. (June, 1929), **36**, 253-257.

SUMMARY.

Observations on *Anthocoris nemorum*, a bug which preys extensively on Red Spider, show that it (and insects with similar habits) may be adversely affected by the use of tar-distillate washes. This may partly account for the rapid increase of Red Spider where these washes are used on fruit trees. Notes on the control of Red Spider are given.

Massee, A. M., and *Steer, W.* THE HATCHING OF *CALOCORIS NORVEGICUS* Geml. The Entomologists' Monthly Mag. (July, 1929). **65**, 160.

SUMMARY.

This capsid, which had previously been observed to lay eggs in chestnut fence posts in August, 1928, was found to be hatching in numbers in June, 1929 from eggs laid in the same posts.

Massee, A. M. NOTE ON PLUM LEAF HOPPERS. The Entomologists' Monthly Mag. (September, 1929), **65**, 206-207.

SUMMARY.

The Oviposition of the Plum Leaf Hoppers, *Typhlocyba quercus* Fab. and *Zygina coryli* Collin is described. Eggs are laid in the stems and branches of plum trees during October. The leaf hoppers emerge during May.

Steer, W. *CALOCORIS NORVEGICUS* ON MULLEIN. The Entomologists' Monthly Mag. (September, 1929), **65**, 209-210.

SUMMARY.

This appears to be a new host record for this Capsid, which swarmed on the flower spikes of mullein plants in a garden and prevented the flowers from opening.

Massee, A. M. THE STRAWBERRY RED SPIDER. The Gardeners' Chronicle, 1929 (3rd Series), No. 2234, **86**, 310-311.

SUMMARY.

The life-cycle of the Strawberry Mite is briefly described. The mites hibernate in the vicinity of the strawberry plants. They may be found in little

colonies amongst the dead leaves and under stones and clods of earth. Some remain on the plants all the winter, in the crowns and other sheltered places.

Massee, A. M. NOTES ON INSECT PESTS. Gardeners' Chronicle, 1929 (3rd Series), No. 2244, **86**, 507-508.

SUMMARY.

The absence of certain insect pests of fruit and vegetables during 1929 is recorded, and it is suggested that the unfavourable weather during the autumn of 1928 might be largely responsible for this phenomenon.

THE CONTROL OF THE FRUIT TREE RED SPIDER ON PLUM.

By A. M. MASSEE,
The Research Station, East Malling, Kent.

The Fruit Tree Red Spider or Mite is one of the most important pests which occur on plums and damsons at the present time. This pest was recorded upon the plum many years ago, but it was not at first considered to be of economic importance. Since 1925 however, the Fruit Tree Red Spider has been increasing in numbers very rapidly, and in 1930 most plum orchards in Kent and other Counties are suffering as the result of mite attack.

The rapid increase of this mite upon the plum is doubtless due to the routine spraying of the trees with a tar-distillate wash which is applied during the dormant season. It is now well known that the tar-distillate washes do not kill the eggs of this mite, but that they actually destroy a number of predaceous insects which normally partially prey upon the mites. Therefore, when the mites emerge from their eggs in the spring, they are able to breed throughout the season, without being checked by their natural enemies. Hence the epidemic of mites on the sprayed trees.

In spite of this fact it has been proved that the tar-distillate washes are of great value to the fruit grower, since they destroy the eggs of such dangerous insect pests as the Leaf-Curling Plum Aphis and the Winter Moth; in addition it has been shown that the Brown Rot disease of plum is completely controlled by these sprays.* For these reasons it is considered imperative to continue spraying with the tar-distillate washes where these insect and fungus diseases occur.

The Fruit Tree Red Spider of plum is the same species as that found on the apple. Now, it has been shown elsewhere,† that when this mite occurs on apple it may be controlled successfully by spraying the trees in the spring when the flower trusses reach the "pink bud" stage. A lime-sulphur spray (one part of L.S. to 29 parts of water) is recommended for this purpose.

Unfortunately this strong, pre-blossom, lime-sulphur spray cannot be used against the same mite on plums successfully. The reason is obvious. The spray has to be applied when the majority of the mites have hatched from their winter eggs (it is known that L.S. does not kill the eggs), and since the

* Plum Aphis and Brown Rot. Lees and Briton-Jones. Journ of Pom. and Hort. Sci. **4**, 196-199.

† The Fruit Tree Red Spider. A. M. Massee. East Malling Res. Sta. Ann. Rep. for 1928 (April, 1929). (I.—General), 116-122.

blossom period of the plum is considerably earlier than that of the apple, hatching does not take place until many varieties of plum are in full flower, and at this period a strong lime-sulphur spray cannot be applied owing to the risk of spray injury to the flowers and opening leaflets.

For this reason an experiment was undertaken to determine whether lime-sulphur and other preparations could be applied safely to plums after the blossom period.

A plantation of half standard Victoria plum trees was selected for this trial, since it is known that Victoria is particularly susceptible to spray injury.

Four distinct washes were tested. Namely, lime-sulphur 1.99 plus .1% gelatine; lime-sulphur 1.99 plus .1% gelatine plus 4 lbs. of Lead Arsenate Paste; White Oil Emulsion 1 : 99 and Bordeaux mixture (Hydrated Lime) (8 : 12 : 100) plus .1% gelatine plus white oil emulsion 1 : 99.

The Bordeaux mixture and the Lead Arsenate sprays were included in the hope of controlling the leaf spot stage of the bacterial canker of plum and the leaf eating weevils respectively, in addition to the Fruit Tree Red Spider.

The sprays were applied by means of a power sprayer, a pressure of 150 lbs. per square inch being used in each case. The first sprays were applied on May 22nd, 1929, about eight days after the fall of the plum blossom; the second application was made on June 6th, and the third on June 22nd.

In order to determine whether the mites had been killed by the sprays a record of the number present on some of the leaves of sprayed and unsprayed trees had to be obtained in the field.

Results of the Spraying Trials.

An examination of the leaves of the unsprayed "control" trees (the trees were growing in the same row as those sprayed with lime-sulphur) showed that there was a very bad infestation of mite, and as a matter of fact the "control" trees remained heavily infested throughout the summer.

The number of mites recorded on the leaves which received the lime-sulphur spray (1 : 99) was almost negligible, and in fact the trees remained free from attack for the rest of the season. It was evident from the figures obtained that the lime-sulphur spray considerably reduced the number of mites per tree. This point was confirmed—only much more strikingly—by comparing the sprayed and unsprayed trees in the field.

The same story applies to the trees which received the lime-sulphur plus arsenate of lead paste spray. These trees were almost freed of mites as the result of the one application. For example, 312 leaves from 20 trees were examined and only 77 living mites were found upon them. A similar number of leaves were examined one week later, and this time only 45 living mites were observed.

The trees which received the white oil emulsion (1%) and those sprayed with Bordeaux Mixture plus white oil emulsion gave very disappointing results in fact nearly as many mites were recorded upon the leaves of these trees, as upon the unsprayed trees. Even two and three applications of these two sprays did not tend to reduce the number of mites, and by the end of the season the trees which received these treatments could not be separated from the unsprayed "control" trees.

During the middle of June, eleven days after the date of the second application of sprays, a third survey of the trees was undertaken in the field. By this time most of the mites had deposited their summer eggs on the leaves, thus for this inventory the actual number of summer eggs had to be recorded rather than the living mites.

The leaves of the unsprayed trees and the lime-sulphur treatments were examined for the third time in this manner. It was quite unnecessary to examine the leaves of the trees sprayed with the white oil emulsion and Bordeaux, since it was evident at a glance that these sprays did not control the mite sufficiently to make this count worth while.

The result of this examination is briefly as follows :

4,566 eggs were recorded on 168 leaves from the unsprayed "control" trees, while only 344 eggs were noted upon 132 leaves of examined trees from the lime-sulphur row. The figures are self explanatory, and it is considered that the relative absence of eggs on the sprayed leaves is due to the fact that most of the mites were killed by the spray, before they deposited their summer eggs on the leaves.

The trees sprayed three times with Bordeaux and those sprayed once with the white oil emulsion were literally covered not only with immature and adult mites but also with their eggs. Towards the middle of July the leaves were distinctly discoloured by the continuous feeding of the mites and in appearance these trees were similar in all respects to the unsprayed trees.

The whole plot was examined from time to time during the summer, the final inspection being made in September prior to leaf fall. The trees sprayed with the lime-sulphur wash (1 : 99) could be distinguished from the other treatments and from the controls at some distance from the plot. The foliage of these trees remained green and healthy until leaf fall, while the leaves of most of the other trees turned brown in colour and many were defoliated prematurely. By this time the mites had commenced to deposit their winter eggs upon the twigs and other protected parts of the trees. Eggs were to be found on all trees, including those sprayed with lime-sulphur, but a far greater number were observed on the unsprayed trees and those sprayed with Bordeaux and white oil emulsion.

It must be remembered that the success of the lime-sulphur, when used for the control of the Fruit Tree Red Spider, depends largely upon the time of application. The spray must be applied when the majority of the winter eggs have hatched, and before the mites from these winter eggs have commenced to deposit their summer eggs on the leaves. It is to be regretted that this period varies each season, but generally speaking there is sufficient time to get the spraying done before the summer eggs are laid on the foliage. In practice the spraying should be carried out about two weeks after the blossoms have fallen when the young fruits are developing.

Spray Injury.

In order to determine whether the various sprays caused any bad effect to the crop or injured the foliage by scorching etc., details upon this important aspect were obtained.

For this purpose the fruits of the sprayed and unsprayed plots were recorded and a comparison of the crop of all the treatments was made after the sprays had been applied.

The number of fruits recorded from the sprayed and unsprayed trees proved to be approximately the same, and there was no significant difference in the percentage left on the trees anywhere. Therefore it can be assumed that the sprays did not cause fruit drop, and incidentally the fruits were not marked or russeted by any of the treatments.

Detailed observations also showed that none of the sprays caused any kind of injury to the foliage and even the newly formed leaves at the apex of the shoots were unharmed by the sprays. Against this the leaves of the unsprayed trees showed distinct red spider damage.

Summary.

1. It has been shown that wherever tar-distillate washes are used, there is a tendency for the Fruit Tree Red Spider to increase and become a pest of economic importance.

2. It is pointed out that the tar-distillate washes must still be used in order to destroy other important pests of the plum.

3. The Fruit Tree Red Spider can be controlled by spraying the plum trees during the growing season, about two weeks after the blossoms have fallen, with a lime-sulphur spray at the rate of one gallon of lime-sulphur to 99 gallons of water plus 1 lb. gelatine.

4. The lime-sulphur spray does not reduce the crop or cause any spray injury.

5. White oil emulsion (1%) and Bordeaux Mixture (8 : 12 : 100) do not control the mite at the strengths used in this experiment.

[*Photo R. V. Harris.*

PLATE I.

THE DEVELOPING FRUITLETS OF A VICTORIA PLUM TREE.

Showing the correct period to apply the post blossom lime-sulphur spray

THE APPLE BLOSSOM WEEVIL: THE RESULTS OF FURTHER INVESTIGATIONS UPON ITS CONTROL.

By A. M. MASSEE.

It is sometimes suggested that the Apple Blossom Weevil might be described as being a beneficial insect, since the larval or grub stage of this weevil causes the "capped" blossoms of the apple and pear trees, and as a result thins out the blossoms to some extent. In some years, such as in 1929, when there happened to be an enormous number of blossoms, the work of the Apple Blossom Weevil might tend to reduce the number of blossoms to some extent, and thus reduce the number of fruits per tree, and in turn obviate the necessity of thinning the crops by hand later in the season. In an average season when the blossoms are not so numerous, and are liable to be destroyed by the frost and other causes, the Apple Blossom Weevil becomes a very serious pest, especially on young trees, where frequently 80 per cent. of the blossoms are "capped" and destroyed by this insect. Surely it is a much better plan to control the weevil as far as this is possible regardless of the fact that thinning operations might prove necessary later on in the season. The first essential is to procure a good crop, which can be regulated after the June drop, should this action be necessary.

Investigations upon the control of the Apple Blossom Weevil have been in progress at East Malling for a number of years, and two detailed reports have been published.*

During 1929 further work on the control of this weevil has been carried out, and it is proposed to summarize the results obtained as briefly as possible.

1. Tests with Corrugated Cardboard Bands and Felt Bands for Weevil Control.

It has been established that large numbers of Apple Blossom Weevils can be trapped in "sack bands" which are placed around the tree trunks during May and in June. In the past it has been the recognized practice to leave the bands on the trees unattended until December, and then remove the bands and destroy the weevils hibernating in them by some means. There are several ways of destroying the weevils, such as by burning the sacking, or by dipping the bands in hot water.

* The Control of the Apple Blossom Weevil. By A. M. Massee. Journ. of Pom. and Hort. Sci., 1924-25, **4**, 24-37.

The Control of the Apple Blossom Weevil. By A. M. Massee. East Malling Res. Sta. Ann. Rep. for 1926 (May, 1927) (**I**.—General), 66-70.

Now on some farms where sacking is not available for banding purposes, a difficulty at once arises. It is necessary to obtain sacking for the specific purpose of banding or to substitute some other form of trap in its stead.

For this reason an experiment was carried out to determine whether corrugated cardboard bands and strips of old carpet felt would make equally efficient traps as the " sack bands " have proved to be in the past.

Three types of bands were used in the test :

(1) Carpet felt of quarter of an inch thickness, cut into strips about six inches wide, of single thickness only.

(2) Strips of corrugated cardboard, covered on smooth surface by grease proof paper, four and a half inches wide and of single thickness only.

(3) Ordinary sacking material, in strips four and a half inches wide, the length of the sacking being twice that of the circumference of the stem of the tree, and folded across the middle to make a double thickness of sacking.

All the bands were put on the trees on the same day during July and were left unattended until the date of their removal at the end of November. After the removal of the bands the weevils hibernating in them were sorted out and counted.

The following Table shows the number of weevils caught in each type of band.

TABLE I.

Comparison of Number of Weevils Caught in Sacking, Felt and Corrugated Cardboard Bands.

Type of Band.	Number of Bands.	Total Weevils.	Average per Band.
Sack Band	48	1,948	40
Carpet Felt	21	4,338	206
Corrugated Cardboard	37	14,448	390

It will be seen that the number of weevils caught in the corrugated cardboard bands amounted to 14,500 while only 1,950 weevils were trapped in the sack bands, despite the fact that eleven more sack bands were examined. The number of weevils found in the carpet felt bands totalled 4,340, which is also a considerable increase compared with those found in the " sack bands."

The fact that more weevils were caught in the corrugated cardboard bands might be explained in this manner :—

First, they are able to crawl in between the various layers of cardboard, which separate on becoming wet after a rainy period ; and, second, the inside layers of the cardboard do not appear to become so sodden after continued rainy weather, as experienced in the autumn of 1929. This is doubtless due to the protection afforded by the covering of grease-proof paper. On the contrary the " sack bands " become saturated after heavy rains, and remain in a wet condition for several days. This may deter the weevils from going into the bands to some extent.

The fact that large numbers of weevils are attracted to the corrugated cardboard bands should be of interest to fruit-growers, since this type of band is much more easily manipulated than the " sack bands." It is a very simple business to take a roll of corrugated cardboard into the orchard, cut off strips the required length, and place them round the trees without any preparation beforehand.

It has been shown that the carpet felt bands also attract the weevils to a very considerable extent, but it is unlikely that this type of band will be used commercially on account of the high cost of the material, and owing to the difficulty of obtaining sufficient felt for banding large acreages.

The total cost of the corrugated cardboard bands as compared with sack bands works out as follows. The estimate in each case is based on two hundred bands, each band being eighteen inches long. The cost of the corrugated cardboard bands, including labour, works out at about ten shillings while in the case of sacking, where new sacking has to be bought the cost is approximately one pound. Thus, when new sacking has to be obtained the cost is double that of the corrugated cardboard bands. However, when old sacking is available on the farm, the cost of both types of bands is about the same.

2. A New Method for the Destruction of Apple Blossom Weevils Trapped in the " Sack Bands."

Although it has been pointed out in the first part of this paper that the corrugated cardboard bands are more efficient than " sack bands," many growers will doubtless continue to use sacking, especially on farms where sacking is available for the purpose. For this reason an experiment was undertaken to find out some method of killing the weevils once they are caught in the bands.

In the past, various methods have been employed, but for one reason or another they have not proved efficient, especially on large farms where hundreds of bands have to be dealt with every year.

It occurred to the writer that it might be possible to destroy the weevils in the bands without removing them from the trees. Therefore an experiment

was carried out in the autumn of 1929 to determine the effect upon the weevils by spraying the bands on the trees with a tar-distillate winter wash.

A number of apple trees which had been banded commercially by a fruit grower in the East Malling district proved suitable for the purpose. The bands of alternate trees were sprayed with a tar-distillate wash, applied at a strength of 10 per cent., during October 1929.

A few days after the spraying had been done, the bands from the sprayed trees, and from the untreated trees were removed and the weevils in them were examined to determine their fate.

Table II. shows a comparison between the weevils of treated and unsprayed bands.

TABLE II.

Comparison between Sprayed and Unsprayed Bands; showing number of Weevils found hibernating in the bands, and on the Trunks immediately beneath them.

Treatment.	Dead.	Paralysed.	Alive.
Sprayed Bands	870	76	41
Sprayed Trunks (under Band)	203	36	31
Totals	1,073	112	72
Unsprayed Bands	27	Nil.	1,268
Unsprayed Trunks (under Bands) ..	20	Nil.	755
Totals	47	—	2,023

It will be seen from the Table that a majority of the weevils in the treated bands and on the trunks were either killed or paralysed by the spray. As a matter of fact only 6 per cent. of the weevils from the treated trees proved to be alive.

It will be noted that a very high percentage of the weevils collected from the unsprayed bands were found to be alive. In fact only forty-seven were found dead and none were paralysed. From these figures, and others of a similarly striking nature which were obtained in this investigation, it can be assumed without doubt that the Apple Blossom Weevil is destroyed by the tar-distillate wash.

The fact that a greater proportion of the weevils were obtained from the unsprayed bands might lead one to suppose that many of the weevils were driven away from the treated bands at the time of spraying. However, this is not considered to be the case. It is more than likely that a large percentage

of these weevils were affected by the spray and died soon after leaving the bands. It has been proved that the weevils die after being sprayed with a tar-distillate wash.

It is well known that a great many weevils hibernate on the bark immediately beneath the band, and not in the bands. Now it has been demonstrated that these weevils are also destroyed by the tar wash, whereas had these bands been removed from the trees and burned, or treated in some other way, these weevils would escape unharmed. In addition many weevils fall to the ground while the bands are being removed, and these naturally escape.

On the farm the bands can be sprayed while the routine winter tar-distillate wash is being applied to the trees but it is essential to soak each band thoroughly with the spray.

In orchards where young apples are staked as a protection against wind it is usual to place a piece of sacking around the tree trunk, where the stake is tied to the tree, to prevent rubbing and damage by the string. Many weevils hibernate in this type of sacking, and these are also destroyed by the spray.

Banded trees should be sprayed during December and in January, and not later, since it has been shown that the weevils leave the bands during February.

Summary.

It is shown that corrugated cardboard bands are more successful than " sack bands " for trapping the Apple Blossom Weevil ; and that strips of old carpet felt also proved to be superior to the " sack bands " when tested under similar conditions.

In addition it is pointed out that the corrugated cardboard bands are much easier to put on the trees as compared with the " sack bands."

A new method of destroying the weevil whilst hibernating in the sack band is described. It has been found that the weevils can be killed by spraying the bands in situ on the trees by means of a 10 per cent. tar-distillate wash.

In addition those weevils hibernating on the trunks immediately beneath the bands are destroyed also.

Finally, the weevils hibernating under the loose bark, and those hiding in the sacking which is placed around the tree trunks, to prevent rubbing and damage by the string, of staked trees are also killed by the winter wash.

Part VI

Hops

Part VI

HOPS

Cultural Trials.

An examination of the results of the manurial trials indicated that the effect of distance apart, due in this case to dead hills, was well worth investigation.

The Seedling Variety, L.21 has been used to plant up a plot for studying the effect of the distance apart of the hills, and the number of bines per string on the field per acre.

Preliminary trials to study the effect of Hard Light and normal pulling, time and degree of severity in cutting, the effect of " stopping " the bines at different heights, have been carried out.

New Seedlings.

The twelve most outstanding of Professor Salmon's seedling varieties tested at Malling during the first 14 years, and now planted out in larger numbers with Commercial varieties as control, have had crop records taken for the first time, and the results are promising.

Certain of the seedling varieties still continue to prove richer in preservative qualities than any of the Commercial varieties tested, when analysed by the Ford and Tait method.

In the Mid-season Hops two new seedlings have been added to those that proved richer than any Commercial variety. Of the Late Varieties six exceeded the highest Commercial variety (Petham Golding), Three of these have not been previously analysed. Of the New Varieties not previously analysed two (411, C9a) proved of superior preservative value to the richest hops obtainable on the market in 1928.

Brewing trials with the most promising seedlings are being continued. Further batches of New Seedlings have been planted out and are undergoing their preliminary trials.

Incidence and Control of Downy Mildew.

There was a fairly severe attack of the " spike " form of the disease in the Spring and early Summer, though the attack was not so severe as in the previous year. No spikes occurred after June 6th compared with July 10th in 1928. There was a slight attack on the cone of some of the more susceptible varieties

just before picking commenced, but the dry and sunny weather during picking checked the spread of the disease.

PUBLICATION DURING THE YEAR.

* *Salmon, Prof. E. S.* TWELFTH REPORT ON THE TRIAL OF NEW VARIETIES OF HOPS AT EAST MALLING. East Malling Research Station, Kent. (Aug., 1929).

Summary.

1. Of the 102 varieties (New and Commercial) tested, twenty-three cropped at the rate of 20 cwt. to the acre or over.

2. The number of bushels (Imperial) of green hops required to the cwt. of dried hops varied in the New Varieties from 68 to 143, and in the Commercial Varieties from 87 to 104.

3. In all the Classes (Early, Mid-season and Late Varieties) certain New Varieties proved on analysis to be richer in preservative qualities than any of the Commercial Varieties tested.

4. Two New Varieties (raised from a " wild " hop from Manitoba, Canada) were richer in preservative qualities by 1.52 per cent. and 1.21 per cent., respectively, than the richest sample of American hops obtainable.

5. Notes are given on the incidence of " Mosaic disease." Certain New Varieties continue to show complete resistance to this disease. Many of the immune varieties have now been found to be " carriers " of this disease.

6. Notes are given on the incidence of the Downy Mildew disease.

* Report issued from East Malling by Prof. E. S. Salmon, South-Eastern Agricultural College, Wye, on data collected jointly upon Hops grown at East Malling.

Part VII

Meteorological Observations

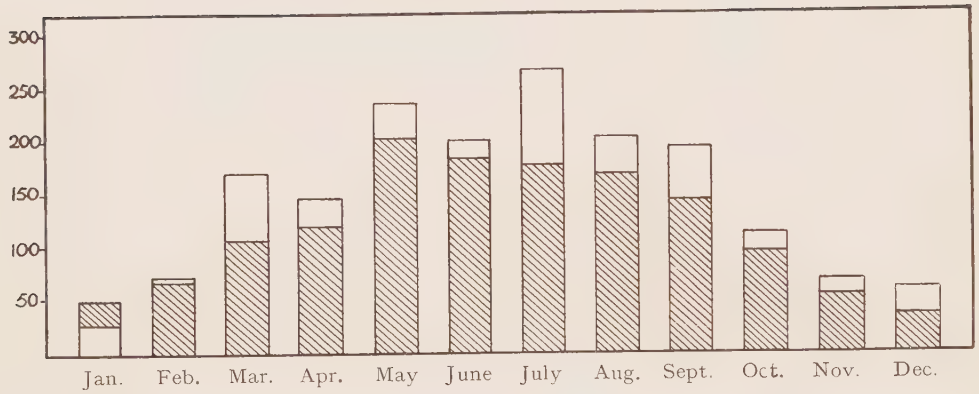
Part VII

WEATHER CONDITIONS DURING 1929

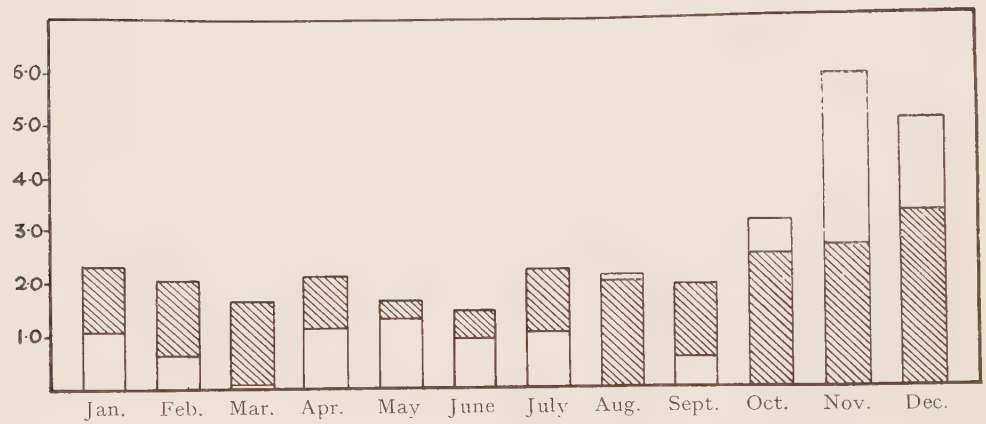
By H. C. CHAPELOW and H. M. TYDEMAN.

From the point of view of the fruit grower the weather conditions experienced during 1929 were almost ideal. The Spring was late and the blossoming of all varieties of hardy fruit was considerably retarded. This circumstance undoubtedly contributed towards the excellent crops of fruit which were actually realized, because, in the first place, all varieties of fruits, the blossoming periods of which are in a normal season, separated by considerable intervals, were in blossom at very much the same time, thus greatly facilitating cross pollination, and secondly, because the flowering of all varieties was delayed until the year was well advanced and conditions were more favourable both for the activities of insects and the maturation of the fertilization process. Actually the weather conditions at the time of blossoming were excellent. Despite the fact that the total rainfall for the year was little less than the average for this district, the year may be described as upon the whole a dry one. Thus while the total rainfall for the year amounted to 23·080 inches, that for the period from January to the end of September was only 8·98 inches, one-half the normal for this period. Sunshine was abundant. The total for the year of 1,800 hours was by several hours a greater aggregate than that of any of the previous years in our records. With regard to temperature the seasons took a very normal course, and marked deviations from the normal expectation did not occur. Somewhat severe conditions, however, were experienced during January and February when frequent and considerable ground frosts occurred. Upon the other hand, extremely warm periods were experienced during July and September, a heat wave of phenomenal intensity occurring during the early part of the latter month. Finally the closing days of the year were marked by gales of considerable violence and prolonged and heavy rainfall.

TOTAL SUNSHINE IN HOURS.



TOTAL RAINFALL IN INCHES.



Diagrams showing Total Sunshine and Rainfall during 1929 compared with previous 15 years average. Shaded portion 15 years average.

SUMMARY OF METEOROLOGICAL OBSERVATIONS DURING 1929.

	Barometer.	Temperature in Screen.				On Grass.			No. of Frosts.	Rainfall.				Sunshine.			Hygrometer.			Wind.
	Mean Reading.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Mean.	Mean.	Lowest.		Total (ins.)	No. of days.	Av. per rainy day.	Heaviest fall in any one day.	Total in hours.	No. of days.	Av. per sunny day.	Mean of dry bulb.	Av. deprec. of wet bulb.	Av. humidity.	Direction.
January ..	29.866	37.8	29.8	47	22	33.8	28.8	16	22	1.02	11	0.09	0.31	28.4	14	2.0	33.4	1.0	89	NNE and SSE
February ..	29.716	37.1	25.6	50	14	31.3	23.0	6	21	0.61	3	0.20	0.44	72.7	16	4.5	30.3	0.8	90	ENE and ESE
March ..	30.267	53.2	31.5	69	19	42.3	26.3	10	22	0.01	1	0.01	0.01	172.2	28	6.1	40.4	1.8	85	NNE
April ..	29.910	52.1	35.3	71	25	43.7	28.4	16	17	1.17	11	0.10	0.31	148.8	28	5.3	44.9	4.1	69	W and NW
May ..	29.997	61.8	42.0	80	25	51.9	36.9	18	6	1.34	6	0.22	0.74	239.6	29	8.3	55.1	5.1	69	NE and SSW
June ..	29.953	66.2	46.5	78	37	56.3	40.0	30	2	0.98	9	0.11	0.31	204.6	28	7.3	58.8	5.7	67	W and NNW
July ..	29.990	72.6	54.3	88	41	63.4	44.6	32	0	1.04	8	0.13	0.29	271.6	31	8.8	65.2	6.6	66	W. and SSW
August ..	29.943	70.7	50.4	86	41	60.5	45.5	37	0	2.19	8	0.27	1.06	208.0	30	6.9	63.1	5.6	71	SW.
September ..	30.055	73.4	50.1	88	35	61.7	43.3	28	2	0.61	4	0.15	0.41	198.6	29	6.8	63.1	4.3	76	N.
October ..	29.791	57.6	41.5	66	28	49.5	35.8	20	7	3.15	13	0.24	0.97	117.7	26	4.5	50.7	2.2	84	SSE and WSW
November ..	29.698	51.3	37.5	59	23	44.4	33.0	16	13	5.885	18	0.33	0.77	72.0	19	3.8	45.0	2.1	88	SSE and SSW
December ..	29.600	48.7	36.7	56	24	42.7	31.0	14	15	5.065	24	0.21	0.69	63.3	20	3.1	42.6	1.4	89	SSW.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	Under POMOLOGY.		
	TOP FRUITS.		
	Root Stocks.		
	Apples.		
E35.	Root System and Tree Performance. *W. S. Rogers.*	Fruit Grower, 1929 .. .. **68**, 646.	Reprints.
	Experimental Technique.		
E37.	The Relationship between the Experimental and the Demonstration Plot and their relative value to the investigator, the County Officer and the Fruit Grower. *T. N. Hoblyn.*	East Malling Res. Sta. Ann. Rep. for 1929. (April, 1930.) (I—General.)	Reprints.
	Under MYCOLOGY AND BACTERIOLOGY.		
	Miscellaneous.		
C48.	Bacterial " Blight " of Walnuts in Britain. *H. Wormald.*	Annals of Applied Biology. 1930. .. **17**, 59-70.	Reprints.
	Apples.		
C49.	Apple Scab at East Malling. *M. H. Moore.*	East Malling Res. Sta. Ann. Rep. for 1929. (April, 1930.) (I—General.)	Reprints.
	Under ENTOMOLOGY.		
	Miscellaneous.		
D54.	The Occurrence of a *Tarsonemid* Mite upon the Cultivated Strawberry in England. *A. M. Massee.*	Gardeners' Chronicle, 1930. (3rd series.) **87**, 2250,110-11.	Reprints.
D55.	Notes on Insect Pests. *A. M. Massee.*	Gardeners' Chronicle, 1929. (3rd series.) **86**, 2244, 507-508.	No Reprints.
D56.	The Red Plum Maggot. *W. Steer.*	The Fruit Grower. 1930 .. .. ..**69**, 1779.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	FIELD SPRAYING.		
D58.	The Control of The Fruit Tree Red Spider on Plum. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1929. (April, 1930.) (I—General.) ..	Reprints.
	APPLES.		
D59.	The Apple Blossom Weevil: The Results of Further Investigations upon its Control. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1929. (April, 1930.) (I—General.)	Reprints.
	Under **BIOCHEMISTRY.**		
K1.	Sulphur as a Soil Fungicide Against the Potato Wart Disease Organism. *W. A. Roach.*	Journ. of Agric. Science. 1930 .. .. **20**, 74-96.	Reprints.
	Under **ANNUAL REPORTS.**		
A12.	Annual Report, 1929. I. General.	East Malling Research Station.	Price 2/6, postage 6d.

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(*b*) To have priority in the matter of sharing in any distributions of novelties (if any) raised by the Station.

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vi. Similar to Group A.

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vi. To be notified of and eligible to attend all Associates days, of which it is hoped to have at least one annually.

vii. Similar to Groups A. and B.

Societies, Associations, Clubs, etc., donating or subscribing similar sums corporately will be admitted to Associate Membership on similar terms. They will be eligible for proportionate privileges for their Members and to send representatives to the General Meetings. Such Associations will also have a prior claim upon the services of any Member of Staff prepared to give Lectures.

All Annual Subscriptions are payable for the Calendar year (January to December). If the subscription is three months over due no further reports or notifications will be sent and membership will lapse.

Life Membership donations may be sent at any time.

In filling up the application form for Membership (at the end of the Report) each prospective member is invited to state the privileges he wishes to exercise.

List of Life Members in the various Groups have already been published.

THIS LIST REFERS TO NEW MEMBERS AND ANNUAL SUBSCRIBERS DURING THE YEAR.

1st January, 1929 to 31st December, 1929.

* Denotes *Life* member as distinct from *Annual* member.
† Denotes *Life* member and *Annual* Subscriber.
‡ Denotes *Life* Founder and *Annual* Subscriber in other Group.

Group A.—"Founders."

*Cambridge West Growers Association (Paskett, A. T.) ..	County Hall, Cambridge.
*Chambers, P. ..	Shepway Court, Maidstone, Kent.
†Chivers & Sons, Ltd. ..	Estate Office, Histon, Cambridge.
*Dartford, N.F.U. ..	13b, Lowfield Street, Dartford, Kent.
*Engelmann, C. ..	Carnation Grower, Saffron Walden, Essex.
‡Greenwell, Sir Bernard ..	Estate Office, Marden Park, Woldingham, Surrey.
†Hardy, Rt. Hon. Laurence	Sandling Park, Hythe, Kent.
Kitchin, J. ..	Boughton Place, Sandway, near Maidstone, Kent.
*Mount, S. W. ..	Hode Farm, Patrixbourne, Canterbury, Kent.
†Wolmer, Lord ..	Blackmoor, Liss, Hampshire.

Group B.—"Fellows."

*Blackmore, H. ..	Littledown, Lamberhurst, Kent.
Bromley-Warner, N. B. ..	Finsbury House, Blomfield Street, London, E.C.2.
Buxton, A. F. ..	Fairhill, Tonbridge, Kent.
Cambridge County Council	Cambridge Education Committee, County Hall, Cambridge.
Columbo Commercial Co., Ltd. ..	(The Secretary), Thames House, Queen Street Place, London, E.C.4.
Essex, Sir R. W. ..	North Drive, Streatham, London, S.W.16.
†Gill, Major J. H. ..	Foxglove, Willesborough, near Ashford, Kent.
Greenfield, G. J. D. ..	32, College Road, Maidstone, Kent.
Hastings Borough Mayor, Aldermen and Burgesses	Town Hall, Hastings, Sussex.
Hillier & Sons ..	Nurserymen, West Hill Nurseries, Winchester, Hampshire.
Isle of Ely Education Committee ..	Education Offices, County Hall, March, Isle of Ely, Cambs.
Jones, L. ..	Plantation, Stock, near Ingatestone, Essex.
Linden Van der H. ..	Carbokrimp Co., Ltd., St. Mary's Chambers, 161a, Strand, London, W.C.2.
Morgan, R. C. ..	Little Whatmans, Biddenden, Kent.
Morley, C. ..	Station Nurseries, Fordham, near Ely, Cambs.

Murphy & Son, Ltd.	..	Wheathampstead, Herts.
Norton, Captain R. A., R.N.		Downs House, Yalding, Kent.
Poix, R. de	..	23, Phillimore Gardens, Kensington, S.W.8.
Richards, W.	..	Poulters, Bentley, Hants.
Snell, Mrs.	..	(*re.* Cobley, Ltd., Messrs.) Sandy Lane, Braunton, N. Devon.
†Warde, Col. Sir Charles Edward	..	Barham Court, near Maidstone, Kent.
West, Samuel	..	Ewhurst Place, Hawkhurst, Kent.

"Group C.—Associates."

Alexander, W.	..	Home Farm, Eynsford, Kent.
Amos, Miss M.	..	Fruit Gardens, Beyton, near Bury St. Edmunds, Suffolk.
Ascherson, C. S.	..	Stede Court, Harrietsham, Kent.
Aspland, A. Lees	..	"Kalgan," Welwyn, Herts.
Baiss, R. S. H.	..	Church House, Beckley, Sussex.
Barnes, W.	..	Southfield, Cooden, near Bexhill, Sussex.
Batt, Lt. Col. R. B.	..	Gresham Hall, Gresham, Norwich, Norfolk.
Batten, S. D.	..	Countessmead, Tiverton, Devon.
Belcher, W. S.	..	Church Farm, Waltham St. Lawrence, Twyford, Berks.
Bennett, Major J. Sterndale		Oaken Wood, Wateringbury, Kent.
Berry, H. A.	..	Iverley, near Stourbridge, Worcester.
Blakeman, A. J.	..	The Schools, Bowdon, Cheshire.
Boardman, S.	..	How Hill, Ludham, Great Yarmouth, Norfolk.
Bowra, C. A. V.	..	The Bower House, Ightham, Kent.
Burnett, Dr.	..	34, High Street, Sevenoaks, Kent.
Burrell, R. J.	..	Risby Place, Bury St. Edmunds, Suffolk.
Calkin, W. S.	..	The Hall, Haddiscoe, Norwich, Norfolk.
Carter, C. D.	..	Hill House Farm, Boxted, Colchester, Essex.
Chambers, Rev. F.	..	Lested Lodge, Chart Sutton, Kent.
Church, King- L. A.	..	Northfield, Albury, near Guildford, Surrey.
Clayton Collins	..	26, Market Place, Wisbech, Cambridge.
Collier, F. J.	..	Heathfield, St. Saviours, Jersey.
†Cook, L. Morton	..	Kingston Orchards, Kingston-by-Sea, near Brighton, Sussex.
Cornwell, B.	..	Iona, Gore Court, Tunstall Road, Sittingbourne, Kent.
Crawford, W.	..	Oakfield, Higham, Kent.
Cronk, F. G.	..	Cromar, Wateringbury, Kent.
Cubitt, E. G.	..	Honing Fruit Farms, Honing, Worstead, Norwich.
Cunningham, Lt. Col. C. C.		Morning Star, Elgin, South Africa.
Dahl, C. G.	..	Alnarp, Akarp, Sweden.
†Danreuther, W.	..	Battle Fruit Farm, Battle, Sussex.
Davis, H. M.	..	Ivy Cottage, Chulmleigh, Devon.
Dering, A.	..	Woodwater, Heavitree, Exeter, Devon.
Dixon, T. & M.	..	Tardebigge, Bromsgrove, Worcester.
Dow, A.	..	George & Dragon, Headcorn, Kent.
Duff, The Hon. Mrs. Grant		16, Mulberry Walk, Chelsea, S.W.3.

Fillmer, Miss S.	..	Oakfield, Hassocks, Sussex.
Findlay Bros.	..	Springhill Nursery, Baillieston, near Glasgow, Lanarkshire.
Freeman, E. H.	..	40, Chancery Lane, London, W.C.2.
Fryer, P. J.	..	(Messrs. Cooper & Nephews (Aus.) Ltd.), 4, O'Connell Street, Sydney, Australia.
Gamble, O.	..	Dunedin, Mark Cross, Tunbridge Wells, Kent.
Gay, Lt. Col. C. H.	..	Higham Hall, near Rochester, Kent.
Gooiland Nurseries (G. Wesseling & Co.)	..	Naarden, Holland.
Gordon, Col. W. A.	..	Warwick Farm, Mulders Vlei, Cape Province, S. Africa.
Green, Capt. L. H.	..	The Whittern Farm, Lyonshall, Kington, Herefordshire.
Green, L.	..	Cherry Trees, Tardebigge, Bromsgrove, Worcester.
Grey, Countess Mabel	..	Howick, Alnwick, Northumberland.
Groom, H. C. & Co.	..	Bellevue Farm, Guilden Sutton, Chester, Cheshire.
Hales, A. T.	..	Gwelo Fruit Farm, Newington, Sittingbourne, Kent.
Hall, F. V.	..	The Pomona Garden Co., New North Road, Exeter, Devon.
Hall, Rev. R.	..	The Manse, Rescobie, Forfar.
Hammond, Miss M. R.	..	St. George's Lodge, Cookham, Berks.
Harraway, T. H. & Son	..	The Nurseries, Warminster, Wiltshire.
Harthan, A. J.	..	Badger's Hill, Sheriffs Lench, Evesham, Worcester.
Hartley Agric. Co-operative Society	..	Hartley, Longfield, Kent.
Have, Van der A.	..	Kapelle, Bij Goes, Holland.
Head, W.	..	Government Botanic Gardens, Saharanpur, United Provinces, India.
Heyst Van B. G.	..	Mauritsstraat 83, Utrecht, Holland.
Hickman, D. R.	..	Romanhurst, Tydd, St. Mary, Wisbech, Cambridge.
Hitchings, P. E. N.	..	Stream View Nursery, Horeham Road, Sussex.
Hogben, E. H.	..	Thanet Mill, Northwood, Ramsgate.
Hollands, W. T.	..	Court Lodge, West Malling, Kent.
Hopwood, W. & Son	..	58, High Street, Cheltenham, Gloucester.
Jackson, W. T.	..	117, High Street, Sittingbourne, Kent.
Jennings, W. J.,	..	Kennington Hall, Ashford, Kent.
Jones, B., Mrs.	..	Coney Hill, Hayes Common, Kent.
Jones, F.	..	Southrop, Lechlade, Gloucestershire.
Keeble, F.	..	Brantham Lodge, Manningtree, Essex.
Kenyon, G. H.	..	Ricklesmere, Kirdford, near Billingshurst, Sussex.
Kingsley Fruit Farm	..	Kingsley, Borden, Hants.
Kirkhope, W. G.	..	Felmere, Felbridge, East Grinstead, Sussex.
Lacey, G. H.	..	Warmley, near Bristol, Gloucestershire.
Lambert, Lieut. D. M.	..	Field Bank, Oxenturn Lane, Wye, Kent.
Lamont, J. C.	..	Gedges Hill, Matfield, Kent.
Langrish & Chalcraft	..	Dabb's Place, Cobham, Gravesend, Kent.

Lewis, N. S	..	Mumford, Wittersham, Kent.
*Lidiard, B. S.	..	Waltham St. Lawrence Fruit Farm, Twyford, Berks.
Locket, Wood-, D. T.	..	New Holme, Bratton, Westbury, Wilts.
Macfarlan, Lt. Col. J. B.	..	Invermay, Knowle, Budleigh Salterton, Devon.
Miles & Co., Ltd., W.	..	16, Church Road, Hove, Sussex.
Monins, J. E.	..	Ringwould, near Dover, Kent.
Moore, F. W. & Co., Ltd.	..	Clarence House, 8, Arthur Street, London, E.C.4.
Moseley, R.	..	Sherfield English, Romsey, Hants.
Murton, E.	..	Langton, Hawksdown, Walmer, Kent.
‡Neame, F. & T.	..	The Offices, Macknade, Faversham, Kent.
Neill, S. B.	..	Sunnyhaye Fruit Farm, Woodbury, near Exeter, Devon.
Noble, W. J. W.	..	Mayfield, Kingswood Road, Shortlands, Kent.
Norbury, F. P.	.	Sherridge, near Malvern, Worcestershire.
O'Brien, H. V.	..	Monare, Foynes Island, Limerick, Irish Free State.
Padwick, H.	..	The Red House, West Ashling, Chichester, Sussex.
Pardoe, Capt. F. S.	..	Hazeldene, Horeham Road, Sussex.
Parsons, E.	..	49, Queen Anne Street, Cavendish Square, London, W.
Parsons, J. R.	..	Little Gillions, Croxley Green, Herts.
Payne, H.	..	Court Lodge Farm, West Farleigh, near Maidstone, Kent.
Phayre, Lt. Col.	..	Belgaum, Woking.
Poupart, J.	..	Holly Farm, Walton-on-Thames, Surrey.
Pree, Maj. Gen. H. de	..	Oak Hill House, Beckley, Sussex.
Priestley, S.	..	" Brackley," Carr Wood Road, Bramhall, Cheshire.
Prichard, Gen. C. S.	..	Princes Risborough, Bucks.
Pye, L. K.	..	Burleigh, Cobham, near Gravesend, Kent.
Quayle, J. B.	..	Valley Farm Bungalow, Brantham, Manningtree, Essex.
Ravenhill, W.	..	Loseberry, Claygate, Surrey.
Reynolds, E.	..	Watford Grammar School, Rickmansworth, Watford, Herts.
Ridgwell, H.	..	Mill House, Orsett, Grays, Essex.
Rimmer, J.	..	Roby Farm, Roby, near Liverpool, Lancs.
Roberts, A. E.	..	The Nurseries, Swanwick, Hampshire.
Roger, R. V.	..	The Nurseries, Pickering, York.
Rowntree, B. S.	..	The Cocoa Works, York.
Ryall, R. B.	..	South Cottage, Brenchley, Paddock Wood, Kent.
Russel, H. J.	..	The Lower Farm, Hatfield Peverel, Chelmsford, Essex.
Sale & Son	..	Nurserymen, East Berks Seed Warehouse, Wokingham, Berks.
Scrutton, Miss M. E.	..	Magpies, Chalfont St. Giles, Bucks.
Sevenoaks N.F.U.	..	Homefield, Sevenoaks, Kent.
Smith, C. & Sons	..	Caledonia Nursery, Guernsey.
Smith, F.	..	Fant, East Peckham, Kent.
Smith, G.	..	Goose Green Farm, Hadlow, Tonbridge, Kent.

Solignum, Ltd.	..	205, Borough High Street, London, S.E.1.
Sowrey, J.	..	Yeoveney Lodge Farm, Staines, Middlesex.
Starkey, J. R.	..	Norwood Park, Southwell, Notts.
Stokes, J. M.	..	Grower & Merchant, Evesham, Worcester.
Stokes, W.	..	Paxford Manor, Campden, Gloucester.
Stone, H. C.	..	Thanet Grange, Prince Avenue, Southend-on-Sea, Essex.
Storrie, D. L.	..	Downfield, Dundee, Scotland.
Strouts, E. W.	..	Bishopsdale Farm, Biddenden, Kent.
Tate, Miss M. Y. E.	..	Hilden, Rye, Sussex.
Tinne, G. E.	..	Rafany, Grassendale Park, Liverpool, Lancs.
Thompson, Lt. Col. E. C. M.		Spellow Hill, Knaresborough, Yorks.
Todd, M. A.	..	Lee Cottage, Sheringham, Norfolk.
Tompsett, B. H.	..	Little Sheephurst Farm, Marden, Kent.
Trechman, N. G.	..	Fruit and Vegetable Grower, Harvington, Evesham, Worcestershire.
Turner, E.	..	Ministry of Agriculture, Wellington Place, Belfast, N. Ireland.
Vanwyngaerden, A. W	..	Directeur, Ecole Moyenne D'Horticulture de L'Etat, Vilvorde, Belgium.
Vinden, F. R., Messrs.	..	Sunnybank Farm, Ltd., Warfield, Berks.
Voss & Co.	..	Carlton Works, Millwall, London, E.14.
Voysey, C. J.	..	Highdown Nurseries, Ferring, Sussex.
Walderslade Smallholders		Oakhurst, Tunbury Avenue, Walderslade, Kent.
Wallace, W. E.	..	The Nurseries, Eaton Bray, Dunstable, Bedford.
Wallinger, Sir John	..	Kingswood, Surrenden Road, Brighton, Sussex.
Wallis, W. M.	..	Bekesbourne Hill, near Canterbury, Kent.
White, F. R. H.	..	Little Langford, Salisbury, Wiltshire.
White & Hiller	..	Dunnington Heath Farm, Alcester, Warwickshire.
Whittome, J. E.	..	Turnham's Gill, Henfield, Sussex.
Wickham, R. D.	..	Gate House Farm, Brenchley, Kent.
Wigan, W. L.	..	Clare Cottage, East Malling, near Maidstone, Kent.
Willis, G. H. A.	..	4, Lyndhurst Road, Hampstead, London, N.W.3.
Wood, T. H. & Sons	..	Fruit Growers, The Mount Offices, Farningham, Kent.
Worts, Dr. C.	..	Penlan Hall, Fordham, Colchester, Essex.

Donations to Development Fund, 1929.

Baiss, R. S. H.	..	Church House, Beckley, Sussex.
Courthope, Sir George L.	..	Whiligh, Sussex.
Maxwell, W.	..	Westwood Farm, Sidcup, Kent.
Robbins, A. J.	..	Vicarage Farm, Hounslow, Middlesex.

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EAST MALLING RESEARCH STATION.

LIST OF PUBLISHED REPORTS TO 31st OCTOBER, 1929.

To be obtained from :—

THE SECRETARY,

East Malling Research Station,

East Malling,

Kent.

CORRECTIONS FOR LIST OF PUBLICATIONS.

On page 3. E17. "Apple Root Stocks" should read **Out of Print** instead of Price 2d.

On page 5. Ep6. "Apple Pruning, etc." should read **62-69** instead of 62-68.

On page 7. H3. "Progress in Methods, etc." should read Journ. of **Royal Agric. Soc. of England,** instead of Journ. of Royal Hort. Soc.

On page 16. D15. "Limanitis, etc." should read **D45** not D15.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	POMOLOGY.		
	TOP FRUITS.		
	Root Stocks.		
	Apples.		
E1.	Paradise Apple Stocks. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1917. .. **42.** 361.	Out of print.
E2.	Paradise Apple Stocks. Their Fruit and Blossom described. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1919. .. **44.** 89.	Out of print.
E4.	Suggestions for the Right Selection of Apple Stocks. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1920. .. **45.** 257.	Out of print.
E9.	Results of Researches on Fruit Tree Stocks. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1920. .. **2.** 1-10.	Out of print.
E8.	The Importance of Suitable Stocks in Planting Young Fruit Trees. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 82.	Out of print.
E10.	The Influence of Root Stock upon the Tree Fruits. *R. G. Hatton.*	Fruit Grower. 1923. .. .. **16.** 639-641; 699-700; 759-760. and Verslag Van Het International Tuinvouw-Congress, Amsterdam, 1923. 94-117.	Out of print.
H5.	The Control of the Fruit Tree Through its Roots. *R. G. Hatton.*	Country Life. 1924. .. .. **55.** 867-869.	No Reprints.
E12.	The Choice of Young Fruit Trees. *R. G. Hatton, J. Amos and N. H. Grubb.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 132-134. and East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925). 93-100.	Price 2d. Postage 1d.
E16.	Some Factors Influencing the Period of Blossoming of Apples and Plums. *R. G. Hatton and N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 81-86.	Price 6d. Postage 2d.
E17.	Apple Root Stocks, their Particular Suitabilities for Different Soils, Varieties and Purposes. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General). 46-52.	Price 2d. Postage 1d.
E19.	The Influence of Different Root Stocks upon the Vigour and Productivity of the Variety Budded or Grafted Thereon. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 1-28.	Out of print.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
E20.	Root Stock Effect on Colour and Size of Apples. *W. S. Rogers.*	East Malling Res. Sta. Ann. Rep. for 1926. (March 1927). (II—Supplement). 16-32.	Out of print.
E30.	Characteristics and Suitability of the So-Called "Paradise" Stocks. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General). 47-50.	No Reprints.
E24.	Root Systems of Some Ten Year Old Apple Trees on Two Different Root Stocks, and their Relation to Tree Performance. *W. S. Rogers and M. C. Vyvyan.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 31-43.	Price 9d. Postage 3d.
E25.	The Northern Spy as a Root Stock. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 44-50.	Price 3d. Postage 1d.
E26.	The Influence of Root Stocks on the Blossoming of Seedling Apples. *H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 51-55.	Out of print.
E32.	The Importance of the Root System. *R. G. Hatton and W. S. Rogers.* *See also* E3, E14, C3, C9, C17 and C38.	Imperial Fruit Show leaflet issued by Empire Marketing Board (1929). Journ. of Kent Farmers' Union. 1929. .. **26.** 120-122.	Reprints available.
	PEARS.		
E5.	A First Report on Quince Stocks for Pears. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1920. .. **45.** 269.	Out of print.
E31.	The Behaviour of Certain Pears on Various Quince Root Stocks. *R. G. Hatton.* *See also* E8 and E12.	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 216-233.	Price 5d. Postage 1½d.
	PLUMS.		
E6.	Stocks for the Stone Fruits. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1921. .. **2.** 209-245.	Price 1/6. Postage 3d.
E7.	Some Notes on Stocks for Plums. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 158.	Out of print.
E23.	Plum Root Stocks: Their Varieties, Propagation and Influence upon Cultivated Varieties Worked Thereon. *R. G. Hatton, J. Amos and A. W. Witt, with Appendix by T. N. Hoblyn.* *See also* E8, E12, E16 and E29.	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 63-99.	Price 4d. Postage 3d.
	CHERRIES.		
E11.	Cherry Stocks: Their Behaviour in the Nursery. *N. H. Grubb and A. W. Witt.* *See also* E6.	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 87-92.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	PROPAGATION.		
E3.	Summary of the Results obtained in Selecting and Propagating Paradise Stocks. *R. G. Hatton.*	The Fruit Grower. 1919. .. .. .. **47.** 1211-1212 Fruit Trades Journal. 1919. .. .. **35.** Gardeners' Chronicle. 1919. .. .. **65.** 71, 82, 100.	Out of print.
E13.	Some Problems of Propagation. Part I. *R. G. Hatton, J. Amos and A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1923. 100-109.	No Reprints.
E28.	Experiments with Double-worked Pears on Quince Stocks. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 11-15.	No Reprints.
E27.	Vegetative Propagation of Walnuts. *A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II Supplement.) 60-64.	Price 4d. Postage 1d.
F5.	Vegetative Propagation of Fruit Tree Root Stocks. *R. C. Knight, J. Amos, R. G. Hatton and A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 11-30.	Price 5d. Postage 2d.
	See also C21, C38, E23, F2 and 3, F3.		
	PRUNING.		
Ep1.	Results of Apple Pruning Experiments. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 114.	Out of print.
Ep2.	Winter Pruning Experiments with Apple Trees. *N. H. Grubb.*	Journ. of the Royal Hort. Soc. 1922. .. **47.** 139.	Out of print.
Ep3.	Notes on Apple Pruning. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1923. .. **13.** 95.	Out of print.
H6.	Pruning Neglected Fruit Trees. *N. H. Grubb and A. W. Witt.*	The Garden. 1924. .. .. .. **88.** 88-89.	No Reprints.
Ep4.	Apple Pruning. Summary of Deductions from Experiments at East Malling. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1925. .. **18.** 150-154.	Out of print.
E18.	Experiments upon the Removal of Lateral Growths on Young Apple Trees in Summer. *R. G. Hatton and J. Amos.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 61-71.	Price 2d.
Ep5.	A Progress Report on Winter Pruning Experiments with Pear Trees. *J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II Supplement.) 65-71.	Price 5d. Postage 2d.
Ep6.	Apple Pruning. Summary of Deductions from Experiments at East Malling. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I General.) 62-68.	Price 3d. Postage 1d.
Ep7.	The Pruning of Apple Trees. *N. H. Grubb.*	Government of Northern Ireland Ministry of Agriculture's Leaflet No. 34.	Copies to be obtained from Sec., Min. of Agric., Wellington Place, Belfast.
	See also E10, E16 and E34.		

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
MANURING.		
E22. An Analysis of the Effects of Potash Fertilizers on Apple Trees at East Malling. *N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 32-59.	Price 5d. Postage 3d.
E33. The Effects of Potash Fertilizers on Apple Trees. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 70-72.	Price 2d. Postage 1d.
SMALL FRUITS.		
RASPBERRIES.		
Esf4. *A Note on the Impurity of Raspberry Stocks. *N. H. Grubb and G. S. Peren.*	Journ. of Pom. and Hort. Sci. 1922. .. **3.** 7-10.	No Reprints.
Esf3. Commercial Raspberries and Their Classification. *N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1922. .. **3.** 11-35.	Out of print.
Esf6. Raspberry Investigations. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1923. 128-130.	No Reprints.
C10. Raspberry Mosaic. *N. H. Grubb and A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1923. 131-133.	No Reprints.
Esf7. Raspberry Varieties and Their Cropping. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 75-80.	Price 2d. Postage 1d.
RED CURRANTS.		
Esf13. Red Currant Varieties. *J. Amos.*	Kent Cherry and Soft Fruit Show Catalogue. 1927. East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I. General.) 73-79.	No Reprints.
BLACK CURRANTS.		
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* Joint Publication with Long Ashton Research Station.

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† This Report was mainly the result of an investigation carried out at the S.E.A. College, Wye, and completed after Dr. Wormald's appointment at East Malling.

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D33.	The Fruit Tree Red Spider. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 116-122.	Price 3d. Postage 1d.
D53.	The Strawberry Red Spider. *A. M. Massee.*	Gardeners' Chronicle. 1929 (3rd Ser.). .. **86.** 310-311.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	HOPS.		
B1.	First Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	The Research and Advisory Dept., S.E.A. College, Wye. January 1918.	Out of print.
B2.	Second Ditto. *Prof. E. S. Salmon.*	Ditto, April 1919.	Ditto.
B3.	Third Ditto. *Prof. E. S. Salmon.*	Ditto, April 1920.	Price 6d.
B4.	Fourth Ditto. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. July 1921.	Ditto.
B5.	Fifth Ditto. *Prof. E. S. Salmon.*	Ditto, July 1922.	Ditto.
B6.	Sixth Ditto. *Prof. E. S. Salmon.*	Ditto, July 1923.	Ditto.
B7.	Seventh Ditto. *Prof. E. S. Salmon.*	Ditto, June 1924.	Out of print.
B8.	‡Eighth Ditto. *Prof. E. S. Salmon.*	Ditto, August 1925.	Price 6d.
B9.	Hop Experiments: The Testing of New Varieties of Hops. *R. G. Hatton and J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 169-175.	No Reprints.
B10.	Manurial Scheme of Trials with Hops. *J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 176-179.	No Reprints.
B11.	Ninth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. Aug. 1926.	Price 6d.
B14.	Manurial Trials with Hops. *J. Amos and T. N. Hoblyn.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 165-171.	Price 6d. Postage 2d.
B12.	Tenth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. Aug. 1927.	Price 6d.
B13.	Eleventh Ditto. *Prof. E. S. Salmon.*	Ditto, August 1928.	Ditto.
B15.	Twelfth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.* *See also* C26, C27 and C30.	East Malling Research Station, Kent. Aug. 1929.	Price 6d.
	MISCELLANEOUS.		
G6.	Spraying Trials with Potatoes, 1918. *Prof. E. S. Salmon and H. Wormald.*	Journ. of Board of Agric. 1919. .. .. **26.** 71.	No Reprints.
G1.	Trial of Wart Resistant Potatoes. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1919. .. **6.** 103.	No Reprints.
G8.	Variety Trials with Oats and Barley, Spring 1920. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1920. .. **8.** 148.	No Reprints.

‡ Reports issued from East Malling by Prof. E. S. Salmon, S.E.A. College, Wye, on data collected jointly upon Hops grown at East Malling.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
G2.	Variety Trials with Potatoes, 1919-20. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **9.** 21.	No Reprints.
G7.	Potato Spraying. Three Years' Results at East Malling Res. Sta. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 8.	No Reprints.
G9.	Wheat Trials at East Malling, 1921. *J. Amos.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 91.	No Reprints.
G3.	Variety Trials with Potatoes, 1921. *J. Amos.*	Journ. of Kent Farmers' Union. 1922. .. **11.** 20.	No Reprints.
G10.	Winter Corn Trials (Wheat and Oats), 1921-22. *J. Amos.*	Journ. of Kent Farmers' Union. 1922. .. **12.** 164.	No Reprints.
G11.	Winter Oat Trials, 1922-23. *J. Amos.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 165.	No Reprints.
G4.	Potato Trials at East Malling Research Station, 1923. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 166.	No Reprints.
G12.	Corn Trials, 1923-24. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 93.	No Reprints.
G5.	Potato Trials at East Malling Research Station. 1924. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 167 & 213.	No Reprints.
G13.	Runner Bean Trials, 1924. *H. C. Chapelow.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 195-203.	No Reprints.
H2.	Weather Conditions during 1924. *H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 204.	No Reprints.
H11.	Weather Conditions during 1925. *H. C. Chapelow and H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General.) 91-93.	No Reprints.
H9.	Weather Conditions during 1926. *H. C. Chapelow and H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General.) 81-83.	No Reprints.
H8.	Rules and Details of Membership, East Malling Research Station, 1925.	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General.) 95-96.	Reprints available.
H12.	Weather Conditions during 1927. *H. C. Chapelow and H. M. Tydeman*	East Malling Res. Sta. Ann. Rep. for 1927. (May 1928.) (I—General.) 85-88.	No Reprints.
E21.	Preservation of Fruit in Natural Colours. *Miss A. D. Mackenzie.*	The Museums Journal. 1928. .. .. **28.** 6-16.	Price 7d.
H10.	Proposed Fruit Soils Survey in Kent. An Account of Its Scope and Methods. *N. B. Bagenal, W. Goodwin and R. G. Hatton.*	Journ. of Kent Farmers' Union. 1928. .. **24.** 225-226.	Reprints available.
H1.	Meteorological Observations.	Contributed monthly to the Kent Farmers' Union Journal.	No Reprints.
H7.	Notes to Fruit Growers.	Contributed monthly to the Kent Farmers' Union Journal.	No Reprints.
O13.	List of Publications to 31st October, 1929.		

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	ANNUAL REPORTS.		
A1.	Annual Report, 1920.	In 1914, 15, 16 brief leaflets outlining initiation of experiments, etc., were published from "Wye College Fruit Experiment Station," Kent.	
A2.	,, ,, 1921.	In 1917, 18, 19, Reports became fuller and were incorporated with those of the Research and Advisory Department, S.E.A. College, Wye, Kent.	
A3.	,, ,, 1922.	In 1920, 21, after incorporation as an independent Research Institute Reports were printed in the Journal of the Kent Farmers' Union (December, 1920 and February, 1922).	
A4.	,, ,, 1923.	In 1922, 23, 24 the Annual Report took the present form of independent publications. That for 1922 and 1923 are now out of print.	
A5.	,, ,, 1924.	East Malling Research Station.	Price 5s., postage 6d.
A6.	,, ,, 1925. I—General.	,, ,, ,, ,,	Price 2/3, postage 4d.
A7.	,, ,, 1925. II—Supplement.	,, ,, ,, ,,	Price 5/6, postage 5d.
A8.	,, ,, 1926. I—General.	,, ,, ,, ,,	Price 2/3, postage 4d.
A9.	,, ,, 1927. I General.	,, ,, ,, ,,	Out of print.
A10.	,, ,, 1926-27. II—Supplement.	,, ,, ,, ,,	Price 5/6, postage 6d.
A11.	,, ,, 1928. I—General.	,, ,, ,, ,,	Price 3/–, postage 6d.

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East Malling,

Kent.

TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
POMOLOGY.		
TOP FRUITS.		
Root Stocks.		
Apples.		
E1. Paradise Apple Stocks. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1917. .. **42.** 361.	Out of print.
E2. Paradise Apple Stocks. Their Fruit and Blossom described. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1919. .. **44.** 89.	Out of print.
E4. Suggestions for the Right Selection of Apple Stocks. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1920. .. **45.** 257.	Out of print.
E9. Results of Researches on Fruit Tree Stocks. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1920. .. **2.** 1-10.	Out of print.
E8. The Importance of Suitable Stocks in Planting Young Fruit Trees. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 82.	Out of print.
E10. The Influence of Root Stock upon the Tree Fruits. *R. G. Hatton.*	Fruit Grower. 1923. .. . .. **16.** 639-641; 699-700; 759-760. and Verslag Van Het International Tuinvouw-Congress, Amsterdam, 1923. 94-117.	Out of print.
H5. The Control of the Fruit Tree Through its Roots. *R. G. Hatton.*	Country Life. 1924. .. .. **55.** 867-869.	No Reprints.
E12. The Choice of Young Fruit Trees. *R. G. Hatton, J. Amos and N. H. Grubb.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 132-134. and East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925). 93-100.	Price 2d. Postage 1d.
E16. Some Factors Influencing the Period of Blossoming of Apples and Plums. *R. G. Hatton and N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 81-86.	Price 6d. Postage 2d.
E17. Apple Root Stocks, their Particular Suitabilities for Different Soils, Varieties and Purposes. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General). 46-52.	Price 2d. Postage 1d.
E19. The Influence of Different Root Stocks upon the Vigour and Productivity of the Variety Budded or Grafted Thereon. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 1-28.	Out of print.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
E20.	Root Stock Effect on Colour and Size of Apples. *W. S. Rogers.*	East Malling Res. Sta. Ann. Rep. for 1926. (March 1927). (II Supplement). 16-32.	Out of print.
E30.	Characteristics and Suitability of the So-Called "Paradise" Stocks. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General). 47-50.	No Reprints.
E24.	Root Systems of Some Ten Year Old Apple Trees on Two Different Root Stocks, and their Relation to Tree Performance. *W. S. Rogers and M. C. Vyvyan.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 31-43.	Price 9d. Postage 3d.
E25.	The Northern Spy as a Root Stock. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 44-50.	Price 3d. Postage 1d.
E26.	The Influence of Root Stocks on the Blossoming of Seedling Apples. *H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 51-55.	Out of print.
E32.	The Importance of the Root System. *R. G Hatton and W. S. Rogers.* *See also* E3, E14, C3, C9, C17 and C38.	Imperial Fruit Show leaflet issu d by Empire Marketing Board (1929). Journ. of Kent Farmers' Union. 1929. .. **26.** 120-122	Reprints available.
	PEARS.		
E5.	A First Report on Quince Stocks for Pears. *R. G. Hatton.*	Journ. of the Royal Hort. Soc. 1920. .. **45.** 269.	Out of print.
E31.	The Behaviour of Certain Pears on Various Quince Root Stocks. *R. G. Hatton.* *See also* E8 and E12.	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 216-233.	Price 5d. Postage 1½d.
	PLUMS.		
E6.	Stocks for the Stone Fruits. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1921. .. **2.** 209-245.	Price 1/6. Postage 3d.
E7.	Some Notes on Stocks for Plums. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 158.	Out of print.
E23.	Plum Root Stocks: Their Varieties, Propagation and Influence upon Cultivated Varieties Worked Thereon. *R. G. Hatton, J. Amos and A. W. Witt, with Appendix by T. N. Hoblyn.* *See also* E8, E12, E16 and E29.	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 63-99.	Price 4d. Postage 3d.
	CHERRIES.		
E11.	Cherry Stocks: Their Behaviour in the Nursery. *N. H. Grubb and A. W. Witt.* *See also* E6.	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 87-92.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	PROPAGATION.		
E3.	Summary of the Results obtained in Selecting and Propagating Paradise Stocks. *R. G. Hatton.*	The Fruit Grower. 1919. .. .. .. **47.** 1211-1212 Fruit Trades Journal. 1919. .. .. **35.** Gardeners' Chronicle. 1919. .. .. **65.** 71, 82, 100.	Out of print.
E13.	Some Problems of Propagation. Part I. *R. G. Hatton, J. Amos and A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1923. 100-109.	No Reprints.
E28.	Experiments with Double-worked Pears on Quince Stocks. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II Supplement.) 11-15.	No Reprints.
E27.	Vegetative Propagation of Walnuts. *A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II Supplement.) 60-64.	Price 4d. Postage 1d.
F5.	Vegetative Propagation of Fruit Tree Root Stocks. *R. C. Knight, J. Amos, R. G. Hatton and A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 11-30.	Price 5d. Postage 2d.
	See also C21, C38, E23, F2 and 3, F3.		
	PRUNING.		
Ep1.	Results of Apple Pruning Experiments. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 114.	Out of print.
Ep2.	Winter Pruning Experiments with Apple Trees. *N. H. Grubb.*	Journ. of the Royal Hort. Soc. 1922. .. **47.** 139.	Out of print.
Ep3.	Notes on Apple Pruning. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1923. .. **13.** 95.	Out of print.
H6.	Pruning Neglected Fruit Trees. *N. H. Grubb and A. W. Witt.*	The Garden. 1924. .. .. .. **88.** 88-89.	No Reprints.
Ep4.	Apple Pruning. Summary of Deductions from Experiments at East Malling. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1925. .. **18.** 150-154.	Out of print.
E18.	Experiments upon the Removal of Lateral Growths on Young Apple Trees in Summer. *R. G. Hatton and J. Amos.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 61-71.	Price 2d.
Ep5.	A Progress Report on Winter Pruning Experiments with Pear Trees. *J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 65-71.	Price 5d. Postage 2d.
Ep6.	Apple Pruning. Summary of Deductions from Experiments at East Malling. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 62-68.	Price 3d. Postage 1d.
Ep7.	The Pruning of Apple Trees. *N. H. Grubb.*	Government of Northern Ireland Ministry of Agriculture's Leaflet No. 34.	Copies to be obtained from Sec., Min. of Agric., Wellington Place, Belfast.
	See also E10, E16 and E34.		

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	MANURING.		
E22.	An Analysis of the Effects of Potash Fertilizers on Apple Trees at East Malling. *N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1928-29. .. **7.** 32-59.	Price 5d. Postage 3d.
E33.	The Effects of Potash Fertilizers on Apple Trees. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 70-72.	Price 2d. Postage 1d.
	SMALL FRUITS.		
	RASPBERRIES.		
Esf4.	*A Note on the Impurity of Raspberry Stocks. *N. H. Grubb and G. S. Peren.*	Journ. of Pom. and Hort. Sci. 1922. .. **3.** 7-10.	No Reprints.
Esf3.	Commercial Raspberries and Their Classification. *N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1922. .. **3.** 11-35.	Out of print.
Esf6.	Raspberry Investigations. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1923. 128-130.	No Reprints.
C10.	Raspberry Mosaic. *N. H. Grubb and A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1923. 131-133.	No Reprints.
Esf7.	Raspberry Varieties and Their Cropping. *N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 75-80.	Price 2d. Postage 1d.
	RED CURRANTS.		
Esf13.	Red Currant Varieties. *J. Amos.*	Kent Cherry and Soft Fruit Show Catalogue. 1927.	No Reprints.
		East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 73-79.	
	BLACK CURRANTS.		
Esf1.	Black Currant Varieties. A Method of Classification. *R. G. Hatton.*	Journ. of Pom. and Hort. Sci. 1920. .. **1.** 145-154.	Out of print.
Esf2.	The " Running-Off " of Black Currants. *R. Wellington, R. G. Hatton and J. Amos.*	Journ. of Pom. and Hort. Sci. 1921. .. **2.** 160-198.	Out of print.
Esf12.	The Blossoming of Black Currants. *H. M. Tydeman.*	The Fruit Grower. 1923. .. .. .. **56.** 266.	No Reprints.
D5.	The Control of Big Bud Mite in the Field. *H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1923. 125-127.	No Reprints.

* Joint Publication with Long Ashton Research Station.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
Esf5.	Black Currant Variety Trials: Reliability of Results. *R. G. Hatton, N. H. Grubb and R. C. Knight.*	Journ. of Pom. and Hort. Sci. 1924-25. .. **4.** 200-220.	Price 6d.
D6.	The Control of the Big Bud Mite in the Field. *R. G. Hatton, J. Amos and H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 158-160; and Journ. of Pom. and Hort. Sci. 1925-26 .. **5.** 124-130.	Price 2d. Postage 1d.
Esf8.	Some New and Old Varieties of Black Currants. *R. G. Hatton and J. Amos.*	Kent Cherry and Soft Fruit Show Catalogue. 1926. 2-8.	Price 2d.
Esf9.	"Reversion" in Black Currants: Its Causes and Eradication. *J. Amos, R. G. Hatton, R. C. Knight and A. M. Massee.*	Kent Cherry and Soft Fruit Show Catalogue. 1927. 3-6.	Price 2d.
Esf10 and Esf11.	"Reversion" in Black Currants. I. Symptoms and Diagnosis of the Disease. II. Its Incidence and Spread in the Field in Relation to Possible Control Measures. *J. Amos and R. G. Hatton.* *See also* D15.	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 167-295.	Price 8d.
	MISCELLANEOUS.		
H3.	Progress in Methods of Practical Fruit Growing. *R. G. Hatton.*	Journ. of Royal Hort. Soc. 1921. .. .. **82.** 49-117.	To be obtained only from the publishers, John Murray, Albemarle Street, London. No Reprints.
H4.	Fruit Growing in Small Gardens. *R. G. Hatton.*	The Garden. 1924. .. .. **88.**	
E15.	Some Factors Influencing Root Development. *R. G. Hatton, N. H. Grubb and J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1923. 110-119.	No Reprints.
E14.	Field Observations on the Incidence of Leaf Scorch upon the Apple. *R. G. Hatton and N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1924-25. .. **4.** 65-77. East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 41-53.	Out of print.
E29.	The Incidence of "Die-Back" Disease in Plum Trees in the Field. *J. Amos, R. G. Hatton and A. D. Mackenzie.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 33-37.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
E34.	The Effects of Various Fruit Growing Practices on Fruit Quality and Market Value. *R. G. Hatton.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) 47-61.	Price 4d. Postage 1d.
	See also C6, C7, C9 and C35.		
	PHYSIOLOGY.		
	PROPAGATION.		
F2 and F3.	Propagation of Fruit Tree Stocks by Stem Cuttings. Part I. *R. C. Knight.* Part II. *R. C. Knight and A. W. Witt.*	Journ. of Pom. and Hort. Sci. 1926. .. **5.** 248-266. 1927-28. .. **6.** 47-60.	Price 6d.
F3.	Propagation of Fruit Tree Stocks by Stem Cuttings. II. Trials with Hard- and Soft-wood Cuttings. *R. C. Knight and A. W. Witt.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 47-60.	Price 3d.
	See also F5.		
	STOCK INFLUENCE.		
F7	Preliminary Observations on the Causes of Stock Influence in Apples. *R. C. Knight.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 51-63.	No Reprints.
	GROWTH.		
F4.	Relation in the Apple Between the Development of Young Shoots and the Thickening of Older Stems. *R. C. Knight.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 72-77.	Out of print.
F6.	A Note on the Orientation of Main Branches and its Relation to Stocks in some "Double-Stock" Apple Trees. *R. C. Knight.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (October 1928.) (II—Supplement.) 56-59.	Price 3d. Postage 1d.
	MISCELLANEOUS.		
F1.	The Carbohydrate-Nitrogen Ratio. *R. C. Knight.*	Science Progress. 1924. .. .. .. **19.** 34-42.	No Reprints.
F8.	Observations on the Water Conductivity of the Stems of Reverted Black Currants. *R. C. Knight.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II Supplement.) 70-72.	No Reprints.
	See also E24.		

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	MYCOLOGY AND BACTERIOLOGY.		
	APPLES.		
C8.	The Spraying of Apples. *N. H. Grubb.*	Gardeners' Chronicle. 1921. .. .. **70.** 326.	No Reprints.
C9.	Notes on the Control of Nursery Stock against Crown Gall. *H. Wormald and N. H. Grubb.*	Gardeners' Chronicle. 1922. .. .. **71.** 198.	Stencilled copy still available.
C3.	The Crown Gall Disease of Nursery Stocks. I. Field Observations on Apple Stocks. *H. Wormald and N. H. Grubb.*	Annals of Applied Biology. 1924. .. .. **11.** 278-291.	No Reprints.
C17.	Field Observations on the Crown Gall of Nursery Stocks. *H. Wormald and N. H. Grubb.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 122-125.	No Reprints. See C14.
C36.	Brown Rot Diseases of Fruit Trees in 1926. *H. Wormald.*	Gardeners' Chronicle. 1927. .. .. **82.** 232.	No Reprints.
C35.	Brown Rot of Apples: The Need for Careful Picking and Sorting. *H. Wormald.*	Journal of the Min. of Agric. 1927 .. **34.** 552-554. East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II Supplement.) 119-120.	No Reprints.
C39.	Preliminary Report on the Incidence and Control of Apple Scab and Apple Mildew. *A. M. Frampton*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 96-107.	Unbound separates.
	See also E14.		
	PEARS.		
C18.	An Unusual Form of Pear Canker. *R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 135-136.	No Reprints.
C34.	Canker in Fertility Pear Trees. *H. Wormald.*	Journ. of Min. of Agric. 1927. .. .. **34.** 162-165. and East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 92-95.	No Reprints.
	CHERRIES.		
	See also C42.		

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	PLUMS.		
C42.	Bacterial Diseases of Stone-Fruit Trees in Britain. I. Preliminary Note on Bacteriosis in Plum and Cherry Trees. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 121-127.	No Reprints.
C45.	On the Cause of " Die-Back " in Plum Trees. *H. Wormald.*	Gardeners' Chronicle. 1928. .. .. **84.** 372-373.	No Reprints.
	RASPBERRIES.		
C4.	The Blue Stripe Wilt of the Raspberry. *R. V. Harris.*	Journ. of Pom. and Hort. Sci. 1924-25. .. **4.** 221-229. and East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 126-134.	Price 6d. See C14.
C20.	Three Raspberry Diseases. *R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General.) 64-70.	Out of print.
C31.	Raspberry Cane Spot and Its Control. *R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1927. (May 1928.) (I General.) 57-63.	Price 5d. Postage 1d.
C43.	The Pathology of the Raspberry: a Summary of Results of Recent Research at East Malling. *R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 128-134.	No Reprints.
	See also C10.		
	HOPS.		
C26.	A Wilt Disease of Hops. *R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II– Supplement.) 92-93.	No Reprints. See C22.
C27.	The Grey Mould of Hops. *H. Wormald and W. F. Cheal.*	Journ. of Min. of Agric. 1926. .. .. **33.** 456-458. and East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 94-95.	No Reprints. See C22.
C30.	The Parasitism of the Hop Leaf-Spot Fungus *Cerospora cantuariensis.* *H. Wormald.*	Trans. Brit. Mycol. Soc. 1928. .. .. **13.** 32-39.	Reprints available.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	FIELD SPRAYING.		
C1.	Tests of Fungicides on Apple Trees. *N. H. Grubb.*	Journ. of Pom. and Hort. Sci. 1921. .. **2.** 93-114.	Out of print.
C7.	Experiences with Fungicidal Sprays. *N. H. Grubb.*	Journ. of Kent Farmers' Union. 1921. .. **9.** 147.	No Reprints.
C6.	Fungicidal Spraying of Apples. *N. H. Grubb and N. B. Bagenal.*	East Malling Res. Sta. Ann. Rep. for 1923. 120-124.	No Reprints.
C5.	Tests of Fungicides on Apple Trees, II. *N. H. Grubb.* *See also* C39.	Journ. of Pom. and Hort. Sci. 1924. .. **3.** 157-173.	No Reprints.
	MISCELLANEOUS.		
C2.	†The Mulberry Blight in Britain. *H. Wormald.*	Annals of Applied Biology. 1924. .. **11.** 169-174.	No Reprints available.
C12.	Parasitic Fungi of Cereals. *H. Wormald.*	Farm Crops. 1925. .. .. **1.** 318-336.	No Reprints.
C13.	A Leaf Blotch of the Shasta Daisy. *H. Wormald.*	Gardeners' Chronicle. 1925. .. .. **78.** 353.	No Reprints.
C14.	Plant Pathology Section. *H. Wormald.* (Includes C15, C16, C17, C4, C18 and C11.)	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 107-136.	Price 5d. Postage 2d.
C15.	Notes on Plant Diseases in 1924. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 110-119.	No Reprints. See C14.
C16.	Mulberry Bacterial Blight. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 120-121.	No Reprints. See C14.
C19.	On the Occurrence in Britain of the Conidial Stage of *Sclerotinia Cydoniæ* Schell. *H. Wormald.*	Trans. of Brit. Mycol. Soc. 1926. .. .. **10.** 303-306.	Reprints available.
C11.	Note on Bacterial Soft Rot of Turnips. *H. Wormald and R. V. Harris.*	Annals of Applied Biology. 1925. .. **12.** 326-329.	No Reprints. See C14.
C21.	On "Burr-Knots" of Fruit Trees. *R. G. Hatton, H. Wormald and A. W. Witt.*	Journ. of Pom. and Hort. Sci. 1925-26. .. **5.** 195-204.	Price 5d.
C22.	Plant Pathology Section. *H. Wormald.* (Includes C23, C24, C25, C26, C27 and C28.)	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 75-96.	Out of print.
C23.	Notes on Plant Diseases in 1925. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 75-86.	No Reprints. See C22.
C24.	A Leaf Blotch of Quince Trees. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 87-88.	No Reprints. See C22.
C25.	Bacterial Rot of Turnips. *H. Wormald and R. V. Harris.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 89-91.	No Reprints. See C22.

† This Report was mainly the result of an investigation carried out at the S.E.A. College, Wye, and completed after Dr. Wormald's appointment at East Malling.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
C28.	A Disease of the Shasta Daisy. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 96-97.	No Reprints. See C22.
C29.	Further Studies of the Brown-Rot Fungi. II. A Contribution to our Knowledge of the Distribution of the Species of Sclerotinia Causing Brown-Rot. *H. Wormald.*	Annals of Botany. 1927. .. .. .. **41.** 287-299.	Reprints available.
C33.	Further Studies of the Brown-Rot Fungi. III. Nomenclature of the American Brown-Rot Fungi: a Review of Literature and Critical Remarks. *H. Wormald.*	Trans. of Brit. Mycol. Soc. 1928. .. .. **13.** 194-204.	Reprints available.
C32.	Report on Plant Pathology, Mycology and Bacteriology for the Years 1926-1927. Section III. (Includes C34, C35, C37, C38, C39, C40, C41, C42 and C43.)	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 75-134.	Price 9d. Postage 3d.
C37.	Notes on Plant Diseases in 1926. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 75-88.	No Reprints.
C38.	" Burr-Knots." *R. G. Hatton, H. Wormald and A. W. Witt.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 89-91.	No Reprints.
C40.	Note on " Black Rot " of Cruciferous Plants. *H. Wormald and A. M. Frampton.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 108-110.	No Reprints.
C41.	Notes on Plant Diseases in 1927. *H. Wormald.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 111-118.	No Reprints.
C44.	The Present Distribution of the Brown Rot Fungi: Its Economic Significance. *H. Wormald.*	Journ. of Min. of Agric. 1928. .. .. **35.** 741-750.	No Reprints.
C46.	Some Diseases of Fruit Trees. *H. Wormald.*	Essex County Farmers' Union Year Book and Ann. Rep. 1929. 279-293.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	ENTOMOLOGY.		
	APPLES.		
D2.	Control of Apple Blossom Weevil. *R. G. Hatton.*	Journ of the Kent Farmers' Union. 1921. .. **9.** 176.	No Reprints.
D3.	Apple Blossom Weevil Experiments. *K. P. Worsley.*	Journ. of the Kent Farmers' Union. 1922. **12.** 30.	No Reprints.
D4.	The Resistance of Apple Stocks to Attacks of the Green Apple Aphis. *A. M. Massee.*	Journ. of Pom. and Hort. Sci. 1924. .. **3.** 191-200.	No Reprints.
D1.	The Control of the Apple Blossom Weevil. *A. M. Massee.*	Journ. of Pom. and Hort. Sci. 1924-25. .. **4.** 24-37.	Price 5d.
		and East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 145-157.	
D19.	The Control of the Apple Blossom Weevil: a Summary of Results. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General.) 66-70.	No Reprints.
D20.	Studies on the Resistance of Apple to the Woolly Aphis. *R. LePelley.*	Journ. of Pom. and Hort. Sci. 1927-28. .. **6.** 209-241.	Price 9d.
D37.	Note on the use of Tar Distillate Spraying and of Greasebanding against the Woolly Aphis of Apple. (*Eriosoma lanigerum* Hausm.) *R. LePelley.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 153-156.	Unbound separates.
D42.	Note on Apple Capsids. *A. M. Massee.*	Gardeners' Chronicle. 1928 (3rd Series). .. **83.** 399-400.	No Reprints.
D44.	Note on the Apple Blossom Weevil. *A. M. Massee.* *See also* D30.	Gardeners' Chronicle. 1929 (3rd Series). .. **85.** 393.	No Reprints.
	BLACK CURRANTS.		
D10.	The Control of the Black Currant Gall Mite. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General.) 76-80.	Price 2d. Postage 1d.
D15.	Experiments in the Transmission of Reversion in Black Currants. *J. Amos, R. G. Hatton, R. C. Knight and A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 126-150.	No Reprints. See D12.
D16.	Observations on the Presence of Mites (*Eriophyes ribis*) upon Black Currant Bushes manifesting Reversion and Big Bud. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 151-152.	No Reprints. See D12.
D25.	The Life History of the Black Currant Gall Mite *Eriophyes ribis* (Westw.) Nal. *A. M. Massee.* *See also* D5, D6, D24, D31 and Esf9.	Bull. Ento. Res. 1928. .. .. .. **18.** 297-309.	Price 6d.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	RED CURRANTS.		
D23.	The Black Currant Gall Mite on Red Currants. *A. M. Massee.*	Journ. Min. of Agric. 1927. . . . . **34.** 693.	No Reprints.
D47.	The Black Currant Gall Mite on Red Currants. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 151-152.	No Reprints. See D27.
D48.	The Black Currant Gall Mite on Red Currants. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I—General.) 123-124.	No Reprints.
	See also D24.		
	RASPBERRIES.		
D8.	Abnormal Leaves of the Himalaya Berry and the Raspberry. *A. M. Massee.*	Gardeners' Chronicle. 1922. . . . . **72.** 281.	No Reprints.
D7.	The Leaf and Bud Mite of the Raspberry. *A. M. Massee.*	Journ. of Pom. and Hort. Sci. 1924-25. . . **4.** 59-61.	No Reprints.
D17.	The Gall Mites of the Himalaya Berry and Raspberry. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 154-156.	No Reprints. See D12.
	See also D34.		
	SYSTEMATIC.		
D21.	Descriptions of Three New Species of Gall-Mites (Eriophyidae) from Sudan. *A. M. Massee.*	Annals and Mag. of Nat. Hist. Ser. 9. 1927. **20.** 372-375.	Reprints available.
D22.	A Contribution to the Knowledge of the Species of Gall Mites (Eriophyidae) of Sussex. *A. M. Massee.*	Annals and Mag. of Nat. Hist. Ser. 9. 1927. **20.** 375-379.	No Reprints available.
D24.	On the Species of Gall Mites (Eriophyidae) Found on the Genus *Ribes*. *A. M. Massee.*	Bull. of Entom. Res. 1927. . . . . **18.** 179-181.	Reprints available.
D40.	The Oviposition of *Calocoris bipunctatus* Fabr. *A. M. Massee and W. Steer.*	Entomologists' Monthly Mag. 1928. . . **64.** 207-208.	No Reprints.
D30.	An Eriophyid Mite on Apple. *A. M. Massee.*	Bull. of Entom. Res. 1928. . . . **19.** 203-204.	Reprints available.
D41.	*Dicyphus errans* Wolff and other Capsidae on Potatoes in Kent. *W. Steer.*	Entomologists. Monthly Mag. 1928. . . **64.** 236-237.	No Reprints.
D29.	Two Species of Gall Mites (Eriophyidae) of the Lilac (*Syringa vulgaris* L.) New to Britain. *A. M. Massee.*	Bull. of Entom. Res. 1928. . . . **19.** 259-260.	Reprints available.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
D31.	A New Eriophyid Mite on Black Currant. *A. M. Massee.*	The Annals and Mag. of Nat. Hist. Ser. 10. 1929. .. .. **3.** 213.	Reprints available.
D32.	The Eggs of Some Hemiptera Heteroptera. *W. Steer.*	The Entomologists' Monthly Mag. 1929. .. **65.** 34-38.	Reprints available.
D49.	The Occurrence of *Gnorimus nobilis* L. in Kent. *A. M. Massee.*	The Entomologists' Monthly Mag. 1929. .. **65.** 93.	No Reprints.
D36.	Note on *Anthocoris nemorum* L. (Hemiptera-Anthocoridae). *W. Steer.*	The Entomologists' Monthly Mag. 1929. .. **65.** 103-104.	Reprints available.
D34.	Capsidae Found on the Genus *Rubus*. *W. Steer.*	The Entomologist. 1929. .. .. .. **62.** 101-108.	Reprints available.
D50.	The Hatching of *Calocoris norvegicus* Gmel. *A. M. Massee and W. Steer.*	The Entomologists' Monthly Mag. 1929. .. **65.** 160.	No Reprints.
D51.	Note on Plum Leaf Hoppers. *A. M. Massee.*	The Entomologists' Monthly Mag. 1929. .. **65.** 206-207.	No Reprints.
D52.	Calocoris norvegicus on Mullein. *W. Steer.*	The Entomologists' Monthly Mag. 1929. .. **65.** 209-210.	
	FIELD SPRAYING.		
D9.	Preliminary Field Trials of Tar Distillate Washes. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 143-144.	Out of print.
D11.	A Quantitative Examination of the Toxicity of 3 : 5 Dinitro-O-Cresol and other Compounds to Insect Eggs, under Laboratory and Field Conditions. *C. T. Gimingham, A. M. Massee and F. Tattersfield.*	Annals of Applied Biology. 1926. .. **13.** 446-465.	Reprints available.
D14.	Tar Distillate Washes. *W. Goodwin, A. M. Massee and R. H. LePelley.*	Journ. of Pom. and Hort. Sci. 1924-25. .. **4.** 275-286. and East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 114-125.	Out of print.
D13.	Field Experiments with Dormant Winter Washes. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 101-113.	No Reprints. See D12.
D26.	Winter Washes: Modern Developments in their Use. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1927. (May 1928.) (I—General.) 70-78.	Price 4d. Postage 1d.
D35.	Tar Distillate Washes and Red Spider. *A. M. Massee and W. Steer.* *See also* D5, D6, D33 and D37.	Journ. of Min. of Agric. 1929. .. .. **36.** 253-257.	Reprints available.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	MISCELLANEOUS.		
D43.	Specimens and Pests received during the Year. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 165-166.	No Reprints.
D12.	Entomology Section. (Includes D13, D15, D16, D17 and D18.)	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II—Supplement.) 101-160.	Price 9d. Postage 3d.
D18.	Notes on Insect and other Pests, 1925. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1925. (March 1927.) (II– Supplement.) 157-160.	No Reprints. See D12.
D15.	*Limanitis sibylla* and *Leocophasia sinapis* in West Sussex. *A. M. Massee.*	Entomologist. 1927. .. .. .. **60.** 224.	No Reprints.
D39.	Capsid Bugs: Some Interesting Observations. *A. M. Massee and W. Steer.*	Gardeners' Chronicle. 1928. (3rd Ser.) .. **84.** 154.	No Reprints. See D27.
D27.	Report on Plant Pathology, Entomology, for the Years 1926-27. Section IV. (Includes D47 and D39.)	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 137-162.	Price 6d. Postage 2d.
D38.	Notes on Insect Pests for the Years 1926-27. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II– Supplement.) 157-162.	No Reprints.
D46.	Beech Gall Mites. *A. M. Massee.*	Sexey's School Mag. 1928 (Midsummer Term). No. 118. 86-87.	No Reprints.
D28.	Further Experiments with Tar Distillate Washes. *A. M. Massee, W. Steer and W. Goodwin.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 137-150.	Price 6d. Postage 2d.
D33.	The Fruit Tree Red Spider. *A. M. Massee.*	East Malling Res. Sta. Ann. Rep. for 1928. (April 1929.) (I. General.) 110-122.	Price 3d. Postage 1d.
D53.	The Strawberry Red Spider. *A. M. Massee.*	Gardeners' Chronicle. 1929 (3rd Ser.). .. **86.** 310-311.	No Reprints.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	HOPS.		
B1.	First Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	The Research and Advisory Dept., S.E.A. College, Wye. January 1918.	Out of print.
B2.	Second Ditto. *Prof. E. S. Salmon.*	Ditto, April 1919.	Ditto.
B3.	Third Ditto. *Prof. E. S. Salmon.*	Ditto, April 1920.	Price 6d.
B4.	Fourth Ditto. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. July 1921.	Ditto.
B5.	Fifth Ditto. *Prof. E. S. Salmon.*	Ditto, July 1922.	Ditto.
B6.	Sixth Ditto. *Prof. E. S. Salmon.*	Ditto, July 1923.	Ditto.
B7.	Seventh Ditto. *Prof. E. S. Salmon.*	Ditto, June 1924.	Out of print.
B8.	‡Eighth Ditto. *Prof. E. S. Salmon.*	Ditto, August 1925.	Price 6d.
B9.	Hop Experiments: The Testing of New Varieties of Hops. *R. G. Hatton and J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 169-175.	No Reprints.
B10.	Manurial Scheme of Trials with Hops. *J. Amos.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 176-179.	No Reprints.
B11.	Ninth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. Aug. 1926.	Price 6d.
B14.	Manurial Trials with Hops. *J. Amos and T. N. Hoblyn.*	East Malling Res. Sta. Ann. Rep. for 1926-27. (Oct. 1928.) (II—Supplement.) 165-171.	Price 6d. Postage 2d.
B12.	Tenth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.*	East Malling Research Station, Kent. Aug. 1927.	Price 6d.
B13.	Eleventh Ditto. *Prof. E. S. Salmon.*	Ditto, August 1928.	Ditto.
B15.	Twelfth Report on the Trial of New Varieties of Hops at East Malling. *Prof. E. S. Salmon.* *See also* C26, C27 and C30.	East Malling Research Station, Kent. Aug. 1929.	Price 6d.
	MISCELLANEOUS.		
G0.	Spraying Trials with Potatoes, 1918. *Prof. E. S. Salmon and H. Wormald.*	Journ. of Board of Agric. 1919. .. .. **26.** 71.	No Reprints.
G1.	Trial of Wart Resistant Potatoes. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1919. .. **6.** 103.	No Reprints.
G8.	Variety Trials with Oats and Barley, Spring 1920. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1920. .. **8.** 148.	No Reprints.

‡ Reports issued from East Malling by Prof. E. S. Salmon, S.E.A. College, Wye, on data collected jointly upon Hops grown at East Malling.

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
G2.	Variety Trials with Potatoes, 1919-20. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **9.** 21.	No Reprints.
G7.	Potato Spraying. Three Years' Results at East Malling Res. Sta. *R. G. Hatton.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 8.	No Reprints.
G9.	Wheat Trials at East Malling, 1921. *J. Amos.*	Journ. of Kent Farmers' Union. 1921. .. **10.** 91.	No Reprints.
G3.	Variety Trials with Potatoes, 1921. *J. Amos.*	Journ. of Kent Farmers' Union. 1922. .. **11.** 20.	No Reprints.
G10.	Winter Corn Trials (Wheat and Oats), 1921-22. *J. Amos.*	Journ. of Kent Farmers' Union. 1922. .. **12.** 164.	No Reprints.
G11.	Winter Oat Trials, 1922-23. *J. Amos.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 165.	No Reprints.
G4.	Potato Trials at East Malling Research Station, 1923. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1923. .. **14.** 166.	No Reprints.
G12.	Corn Trials, 1923-24. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 93.	No Reprints.
G5.	Potato Trials at East Malling Research Station. 1924. *R. G. Hatton and J. Amos.*	Journ. of Kent Farmers' Union. 1924. .. **16.** 167 & 213.	No Reprints.
G13.	Runner Bean Trials, 1924. *H. C. Chapelow.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 195-203.	No Reprints.
H2.	Weather Conditions during 1924. *H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1924. (Nov. 1925.) 204.	No Reprints.
H11.	Weather Conditions during 1925. *H. C. Chapelow and H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1925. (June 1926.) (I—General.) 91-93.	No Reprints.
H9.	Weather Conditions during 1926. *H. C. Chapelow and H. M. Tydeman.*	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I—General.) 81-83.	No Reprints.
H8.	Rules and Details of Membership, East Malling Research Station, 1925.	East Malling Res. Sta. Ann. Rep. for 1926. (May 1927.) (I General.) 95-96.	Reprints available.
H12.	Weather Conditions during 1927. *H. C. Chapelow and H. M. Tydeman*	East Malling Res. Sta. Ann. Rep. for 1927. (May 1928.) (I—General.) 85-88.	No Reprints.
E21.	Preservation of Fruit in Natural Colours. *Miss A. D. Mackenzie.*	The Museums Journal. 1928. .. .. **28.** 6-16.	Price 7d.
H10.	Proposed Fruit Soils Survey in Kent. An Account of Its Scope and Methods. *N. B. Bagenal, W. Goodwin and R. G. Hatton.*	Journ. of Kent Farmers' Union. 1928. .. **24.** 225-226.	Reprints available.
H1.	Meteorological Observations.	Contributed monthly to the Kent Farmers' Union Journal.	No Reprints.
H7.	Notes to Fruit Growers.	Contributed monthly to the Kent Farmers' Union Journal.	No Reprints.
O13.	List of Publications to 31st October, 1929.		

	TITLE.	JOURNAL OF PUBLICATION.	REPRINTS.
	ANNUAL REPORTS.		
A1.	Annual Report, 1920.	In 1914, 15, 16 brief leaflets outlining initiation of experiments, etc., were published from "Wye College Fruit Experiment Station," Kent.	
A2.	,, ,, 1921.	In 1917, 18, 19, Reports became fuller and were incorporated with those of the Research and Advisory Department, S.E.A. College, Wye, Kent.	
A3.	,, ,, 1922.	In 1920, 21, after incorporation as an independent Research Institute Reports were printed in the Journal of the Kent Farmers' Union (December, 1920 and February, 1922).	
A4.	,, ,, 1923.	In 1922, 23, 24 the Annual Report took the present form of independent publications. That for 1922 and 1923 are now out of print.	
A5.	,, ,, 1924.	East Malling Research Station.	Price 5s., postage 6d.
A6.	,, ,, 1925. I—General.	,, ,, ,, ,,	Price 2/3, postage 4d.
A7.	,, ,, 1925. II—Supplement.	,, ,, ,, ,,	Price 5/6, postage 5d.
A8.	,, ,, 1926. I—General.	,, ,, ,, ,,	Price 2/3, postage 4d.
A9.	,, ,, 1927. I General.	,, ,, ,, ,,	Out of print.
A10.	,, ,, 1926-27. II—Supplement.	,, ,, ,, ,,	Price 5/6, postage 6d.
A11.	,, ,, 1928. I—General.	,, ,, ,, ,,	Price 3/–, postage 6d.

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